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Friction of Bends in Air Pipes

BY J. H. KINEALY

The easiest way to allow for the friction of a bend or irregular shape in a pipe for conveying air is to find the length of straight pipe of the same size as that of the bend or irregular shape for which the resistance due to friction is the same as for the bend or irregular shape, and add this length to the measured length of the pipe. In this way the total equivalent length of the pipe is obtained, and the friction of this equivalent length of pipe is the friction of the actual pipe with all of its bends and irregular shapes. It is easier and shorter to find this equivalent length of pipe and then calculate the friction due to it for the given quantity of air flowing through it per minute than it is to calculate the friction of the straight parts of the pipe and of each of the various bends or irregular shapes and add these various amounts together to get the total friction.

For each bend there is certain lenth of straight pipe of the same size as the bend for which the friction is the same as for the bend, and this length in feet of pipe may be obtained by multiplying the size of the pipe by a certain constant or coefficient which we may call k. By the size of the pipe we must understand the side of the pipe if it is of a square cross-section; or the diameter of the pipe if it is of a circular cross-section. The side or diameter of the pipe must be in inches.

The value of the coefficient k differs with each different kind of bend, and in order to facilitate the work of those who have to lay out heating and ventilating systems a number of bends commonly found in ordinary work are illustrated and the value of k given for each. These bends are supposed to be either square or round, but the value of k given for a particular bend may be used for a similar bend of a rectangular cross-section, provided that the length of the short side of the rectangle is not less than half the length of the long side, and, also, that in calculating the length of equivalent straight pipe the side of a square of the same area as the rectangular cross-section be used. Thus the friction in a bend of a pipe whose cross-section is 10x20 inches is about the same as that in a similar bend of a pipe whose cross-section is 14x14 inches.

One of the commonest bends in ordinary work is the 90-degree square bend shown in Fig. 1. Here the inner sides make an angle of 90 degrees with one another and the corner is not rounded off at all, but the outer sides meet on the arc of a circle whose center is the corner of the inner sides and whose radius is the side of the pipe or d. Hence the radius of a curve joining the center line of the two branches of the bend would be one-half the size of pipe of $0.5d$. The value of the coefficient of such a bend may be taken as 5. That is to say, the length of a straight pipe in which the friction is the same as that of the bend, shown in Fig. 1, is 5 times the side of the pipe if the pipe is square or 5 times the diameter of the pipe if the pipe is round, the side or diameter being in inches in either case.

Thus a bend like that in Fig. 1 has the same effect, so far as friction is concerned, as increasing the length in feet of the pipe by an amount equal to 5 times the size of the pipe in inches. Such a bend in a 12-inch pipe has the same effect, so far as friction is concerned, as a straight length of pipe 60, equal 5 times 12, feet long. This means, of course, that if we have two 12-inch pipes each 60 feet long, one perfectly straight and the other having one square bend, such as shown in Fig. 1, the friction in the pipe with the bend would be the same as that in a pipe 120 feet long, or twice as great as that in the straight pipe.

Fig. 2 shows a bend where the radius of the inner side is one-half the size of the pipe and the radius of the outer side is one and one-half the size of the pipe, so that the radius r of the middle of the pipe is equal to the size d of the pipe. For such a bend the value of k is 4, and the friction in the bend is equal to that in a straight pipe whose length is $4d$. A bend like this in a 12-inch pipe would offer as much resistance to the flow of air as a straight length of pipe 48, equal to 4x12, feet long.

Fig. 3 shows what may be termed an ordinary round 90-degree bend. The radius of the inner side is d, the size of the pipe and the radius of the outer side is $2d$, or twice the size of the pipe. Hence the radius r of the middle line of the pipe is $1.5d$. The friction in this bend is about the same as that in a straight pipe whose length in feet is 3 times the size of the pipe in inches, and, therefore, k is 3. Such a bend in a 12-inch pipe would be made so that the curve of the inner side would have a radius of 12 inches and the curve of the outer side a radius of 24 inches; and the friction would be the same as that in a straight 12-inch pipe 36 feet long.

The bend shown in Fig. 4 is a long sweep bend for which k is equal to 2. The radius r of the center line of the bend is twice the size of the pipe or $2d$. This means, of course, that the radius of the inner curve is $1.5d$ and the radius of the outer curve is $2.5d$. The friction of such a bend in a 12-inch pipe is the same as that in a straight 12-inch pipe 24 feet long.

Figs. 5 and 6 show forms of compound bends that are sometimes impossible to avoid in erecting air piping. The friction of such bends becomes a very serious matter, and it is of the utmost importance that proper allowance be made for it, if anything like a proper flow of air be expected through pipes in which they occur.

Fig. 5 is a double bend made up of two bends like the one shown in Fig. 2. The radius r of the middle line of each bend is equal to d, the size of the pipe and the resistance to the flow of air through such a compound bend is equal to that in a straight pipe whose length in feet is 8 times the size of the pipe in inches. That is to say, k is 8. The friction of such a bend in a 12-inch pipe is the same as that in a straight 12-inch pipe whose length is 8x12 or 96 feet.

The compound bend shown in Fig. 6 is made up of three bends, such as that shown in Fig. 2. r for each bend is equal to d and k is 12. Hence the friction of such a bend in a 12-inch pipe is the same as that in a straight 12-inch pipe 144 feet long.

If we were conveying air through three 15-inch pipes each 50 feet long, one straight, one with a bend like that shown in Fig. 5 and one with a bend like Fig. 6, the friction of the second pipe with the bend like Fig. 5 would be the same as that in a straight pipe 50+120, equal 170, feet long; and the friction in the third pipe with the bend like Fig. 6 would be the same as in a pipe 230, equal 50+12x15, feet long. That is, the friction in the second pipe would be 3.4, equal to 170 divided by 50, times as great as that in the first pipe, and the friction in the third pipe would be 4.6, equal to 230 divided by 50, times as great as the friction in the first pipe. It is evident, therefore, that the flow of air through the three pipes could not be the same.

When horizontal pipes are connected to vertical flues, the connection is usually made with a square 90-degree bend, like that shown in Fig. 1, for

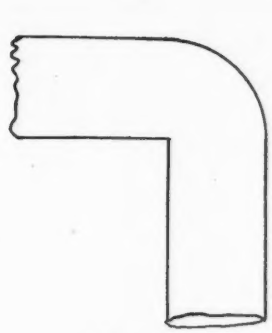


FIG. 1
Radius of Center Line = 0.5 d
k = 5

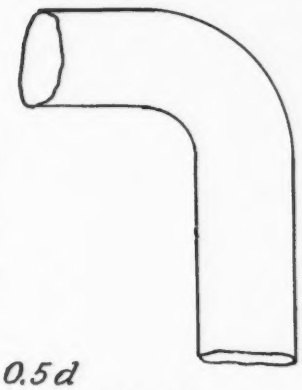


FIG. 2
Radius of Center Line = d
k = 4

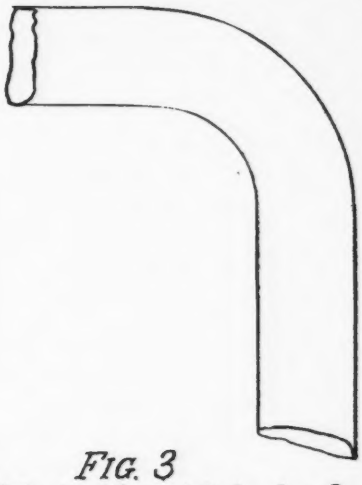


FIG. 3
Radius of Center Line = 1.5 d; k = 3

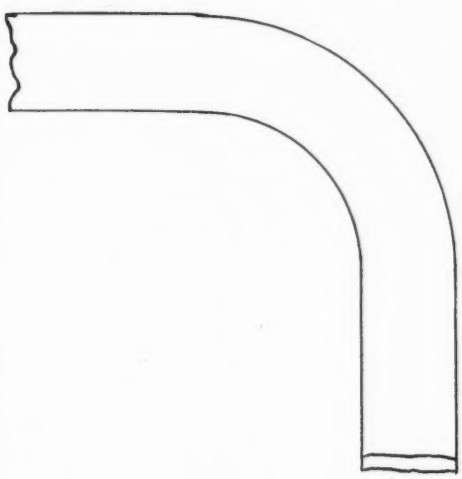


FIG. 4
Radius of Center Line = 2 d; k = 2

FIG. 6
Radius of Center Line = d; k = 12

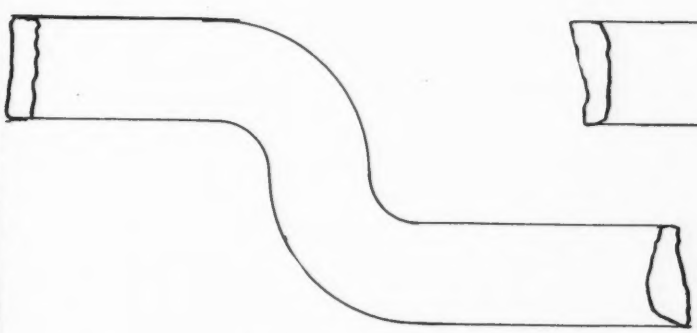


FIG. 5
Radius of Center Line = d; k = 8

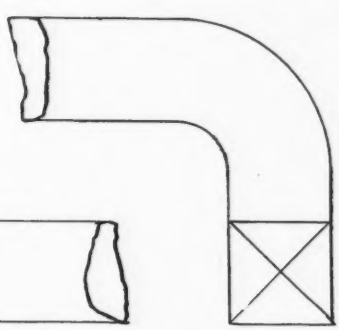


FIG. 7
Radius of Center Line = d; k = 9

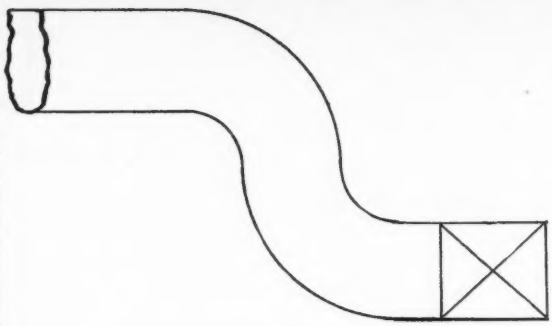


FIG. 8
Radius of Center Line = d ; k = 13

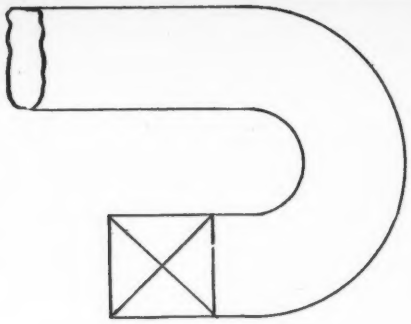


FIG. 9
Radius of Center Line = d ; k = 13

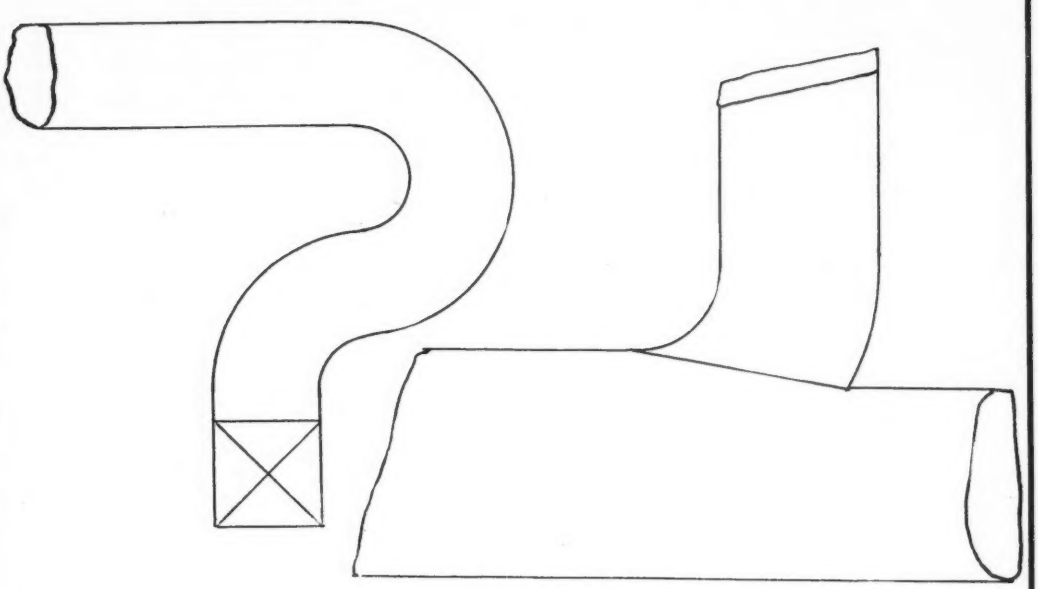


FIG. 10
Radius of Center Line = d; k = 17

FIG. 11

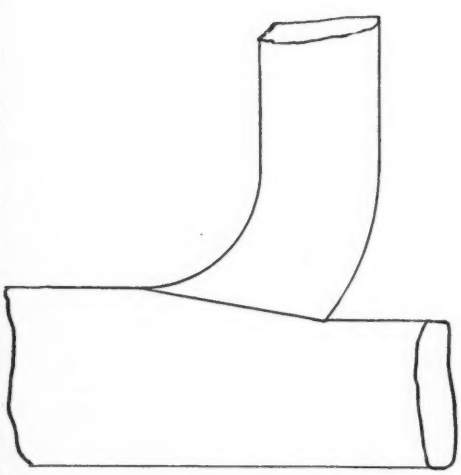


FIG. 12

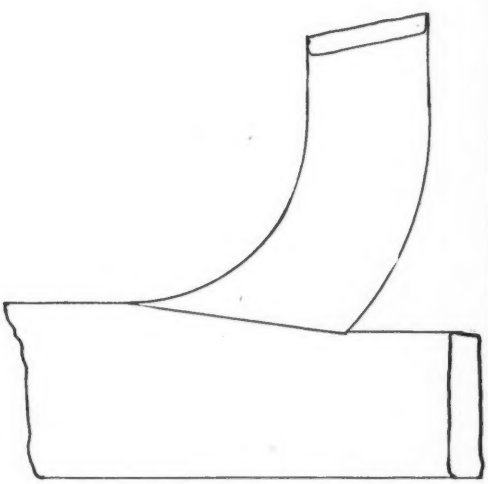


FIG. 13

which k is 5. Sometimes, indeed, both corners are square and the outer side is not rounded at all. In such a case it is probable that it is not far wrong to say that k should be taken as 7 instead of 5, although it is almost impossible to give an exact value to k for such a bend.

Sometimes because of conditions over which the designer has no control it is impossible to avoid such bends as are shown in Figs. 7, 8, 9 and 10 when making a connection between a horizontal pipe and a vertical flue. These, of course, add very materially to the friction of the air.

Fig. 7 shows a connection between a horizontal pipe and a vertical flue, where the pipe must be bent like Fig. 2 in order to get it into the opening of the flue, and the connection between the flue and the pipe is a square bend like Fig. 1. The radius r of the middle of the bend in the pipe is d, the size of the pipe, and k for the connection is 9. That is to say, k is equal to the sum of the values of k for the bends shown in Figs. 1 and 2.

Fig. 8 is a connection made up of a compound bend like that shown in Fig. 5 in the pipe and a bend like Fig. 1 between the pipe and the flue. The value of k for this connection is 13.

The value of k for a connection between a pipe and a vertical flue like that shown in Fig. 9 is also 13. This connection consists of two 90-degree bends like that shown in Fig. 2, and a connection between the pipe and the flue like that shown in Fig. 1.

In Fig. 10 is shown a connection made up of a bend such as is shown in Fig. 6, and a bend between the pipe and the vertical flue like that shown in Fig. 1. The value of k for this connection is 17.

When we consider branches from a main trunk pipe it becomes almost impossible to give anything like even a fair approximation to the resistance to the flow when designing a system of piping, because we can never say how the contractor for the galvanized iron work will make the branches, and further because every branch taken from a trunk line must have a deflecting damper by which the flow into the branch may be regulated and controlled.

The writer usually assumes that the resistance to the flow from a main into a branch is the same as the friction of the bend shown in Fig. 3, where k is equal to 3, and then tries to have the piping put up so that the resistance will not be more than that due to the bend in Fig. 3.

Figs. 11, 12 and 13 show connections between a branch pipe and a main suitable only to square or rec-

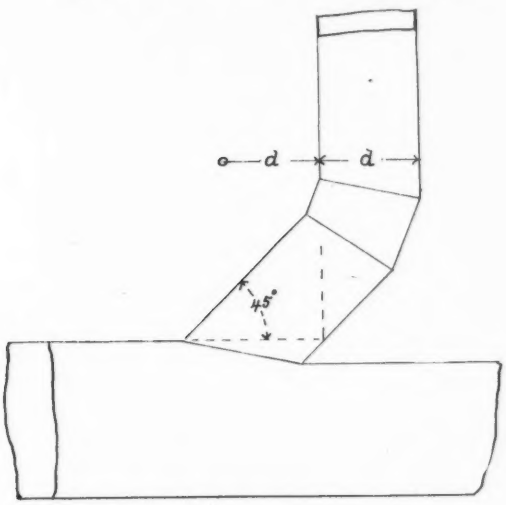


FIG. 14

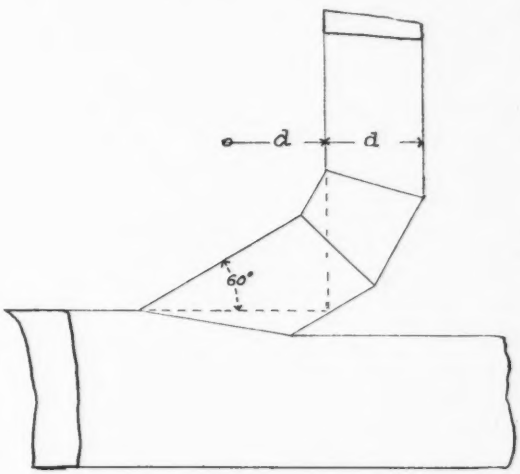


FIG. 15

FRICTION OF BENDS IN AIR PIPES

tangular branch pipes, and Figs. 14 and 15 show connections suitable for either square or round pipes.

The connection shown in Fig. 11 is bad. The radius of the curve of the inner side is equal to one-half the side of the branch, and the radius of the curve of the outer side is equal one and one-half the side of the branch. The connection is too short and abrupt, and it is difficult to make the air pass from the main into the branch, as the tendency is for the air to pass on by the branch inlet. It is probable that the resistance of such an inlet is at least equal to that of a square 90-degree bend, as shown in Fig. 1.

Fig. 12 shows a better connection for a branch to a main, and it is probable that its resistance to the flow of air into the branch pipe is not less than that due to a bend such as is shown in Fig. 2. Here the radius of the inner curve is equal to the side of the pipe, and the radius of the outer curve is twice the side of the pipe.

Fig. 13 shows a very good form of connection for a branch pipe to a main, and it is probable that the resistance offered to the air by it is about the same as that of the bend in Fig. 3. Here the radius of the inner curve is one and one-half the side of the pipe and the radius of the outer curve is two and one-half the side of the pipe, thus making the radius of the middle line of the connection equal to twice the side of the pipe.

Figs. 14 and 15 are self-explanatory so far as the construction of the connections are concerned. It is very difficult to make more than a crude approximation as to the resistance offered by either to the flow of air from the main into the branch. It is probably safe to say, however, that the resistance offered to the flow of air by the connection shown in Fig. 14 is not less than that offered by a bend such as is shown in Fig. 2, for which k is 4; and, also, that the resistance offered by the connection in Fig. 15 is not less than that of a bend such as is shown in Fig. 3, for which k is 3.

Heating and Ventilating a Modern Bank Building

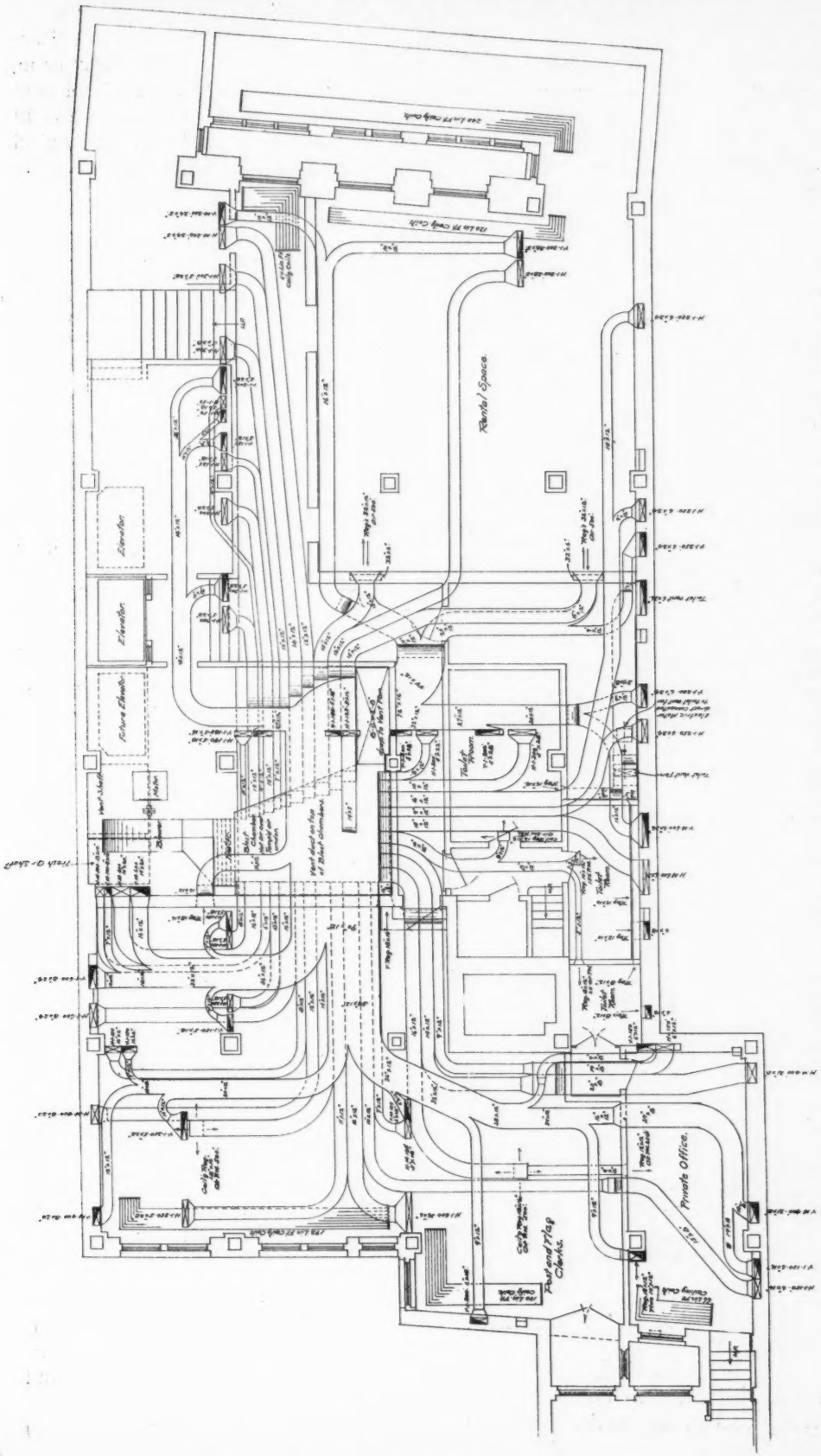
Heating and ventilating plants in banks and similar buildings are usually worthy of study for the reason that the matter of expense is not so closely scrutinized as in some other classes of buildings. This is especially true in the money centers where many of the banking institutions and their appointments easily represent the highest development of the builder's art.

The installation described herewith is designed for one of New York's new banking houses, that of Redmond & Company, on Pine street, the structure itself being the ordinary type of city business building—long and narrow—and four stories in height, with the possibility of additional stories being added to it in the future.

The attempt to secure an extended ventilating system, as that provided, in such narrow quarters, is an interesting feature of the plan. The unusually large sizes of the steam mains and risers is explained by the possible enlargement of the building later on.

As will be noted, heat is furnished by direct radiation, with an auxiliary indirect system for ventilating purposes. The latter is so arranged that practically every compartment in the bank proper has separate ventilating registers, making it possible to maintain in different parts of the same room (for the partitions do not extend to the ceiling) as many variations of temperature as the occupants of its various parts may desire.

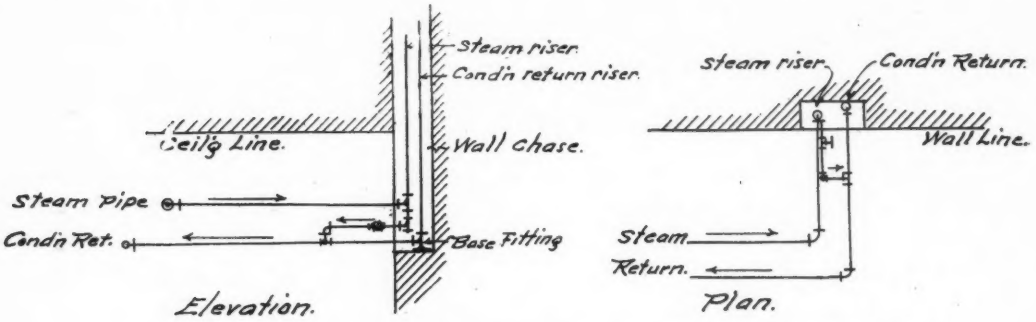
The fact that there is no boiler in the building, the steam being supplied from a street main of the New York


Elevator
Elevator
Future Elevator
Vault
Vault Light
Vault about on line of Basement
Toilet Room
Toilet Room
Toilet Room
Toilet Room
Private Office.
Vault Light
Vault Light
Vault Light

Steam Company, saves some much-needed space and furnishes the desired room for the ventilating apparatus.

VENTILATING SYSTEM

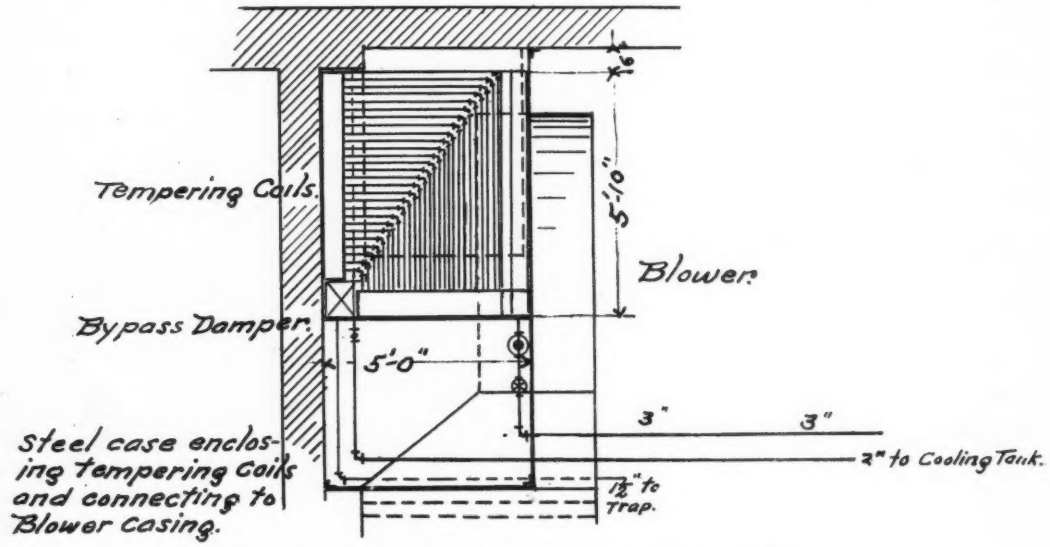
This apparatus is located in the center of the basement. The blower is of the three-quarter housed type, having a wheel 5 feet in diameter by 2 feet 8 inches width of case, designed to operate at 230 R. P. M. and delivering at that speed 12,000 cubic feet of air per minute. It is run by a direct current, 230 volt electric motor, having a capacity of 5 H. P. at 260 R. P. M. It is direct connected to the fan shaft.



SKETCH SHOWING BLEEDER CONNECTION AT BASE OF EACH RISER

The blast coils in connection with the ventilating system consist of a tempering coil group and a reheater coil group. The temperature and reheater coils are of the miter type, each coil consisting of a vertical cast iron steam header and a horizontal condensation return base, connected with 1-inch pipe and with malleable iron elbows at the miter. The pipes are set staggered.

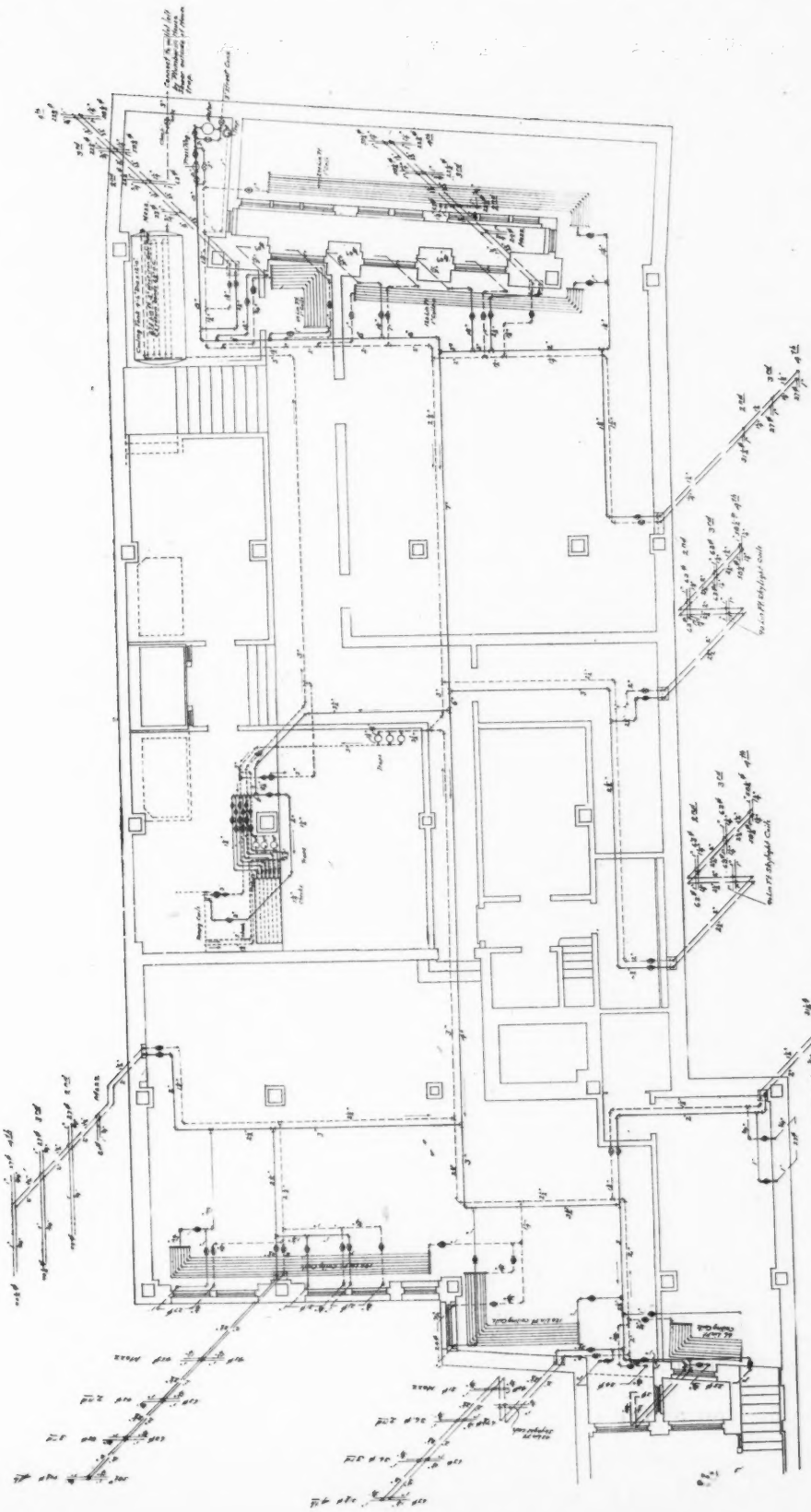
The tempering coil group consists of one 5x6 foot section, four rows of pipe deep and one 5x6 foot section, two rows of pipe deep. In the reheater group are six 5x6 foot sections, each two rows of pipe deep.



PLAN OF TEMPERING COILS, SHOWING CASING AND BLOWER

The four-row tempering coil section is for hot water and the two-row tempering section and the reheater coil sections will be supplied with steam.

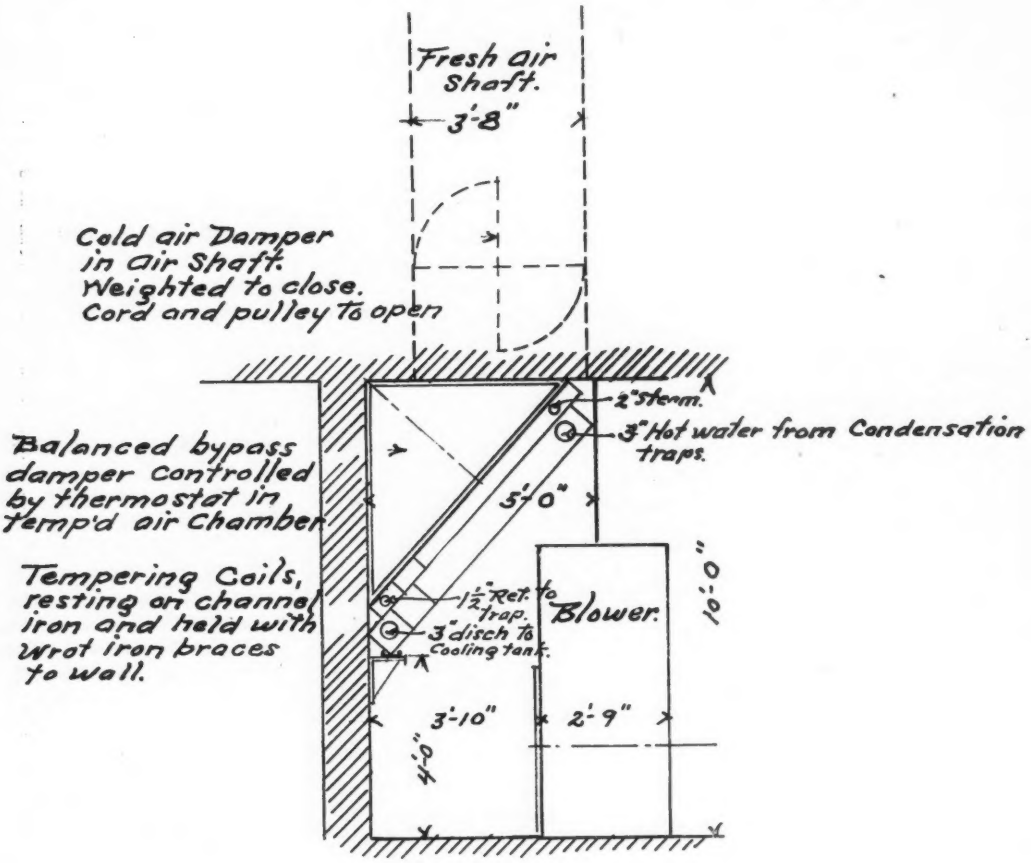
Each two-row section contains 359



PLAN OF STEAM PIPING IN THE REDMOND BANK BUILDING

linear feet of 1-inch pipe, and the four-row sections have 718 linear feet of pipe the same size. The free area through each section is 1,910 square inches.

A steel casing extends from the ceiling of the fan room to the floor, enclosing the fan and reheater coils. A similar case extends from the discharge of the fan, enclosing the reheater coils and forming the hot and tempered air blast chambers, with a division platform separating the two chambers.


Fresh air Shaft.
3'-8"
Cold air Damper in Air Shaft. Weighted to close. Cord and pulley to open
2" Steam.
3" Hot water from Condensation traps.
Balanced bypass damper controlled by thermostat in temp'd air Chamber
5'-0"
Tempering Coils, resting on channel iron and held with wrot iron braces to wall.
1½" Ret. to trap.
3" disch. to Cooling tank.
Blower.
10'-0"
3'-10"
2'-9"
4'-0"

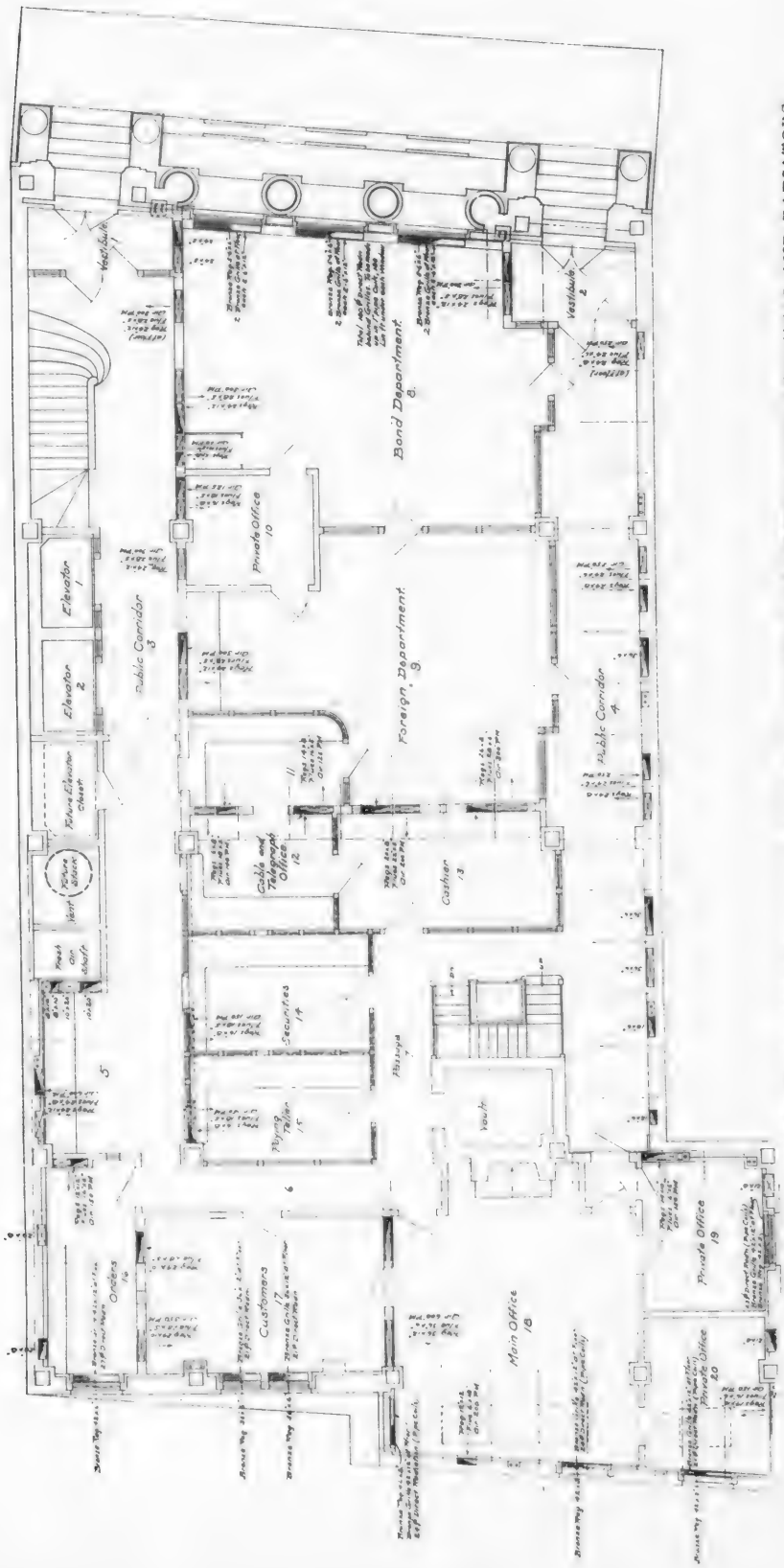
ELEVATION OF TEMPERING COILS, SHOWING BY-PASS DAMPER AND COLD AIR DAMPER IN FRESH AIR SHAFT

Underneath the reheater coils and between the foundation piers is a by-pass damper, with crank handle, for hand operation. Another by-pass damper is located at the end of the tempering coils, balanced for thermostatic control.

All of the hot air ducts are equipped with thermostatic mixing dampers, volume dampers and deflectors to control the flow of air to the different rooms. Independent vent flues lead from the basement toilet rooms to the court at the fourth floor, with circular extension ducts to the roof. Galvanized iron vent ducts also connect from the toilet rooms in the basement to the toilet vent fan and thence through the discharge duct to ventilators in the roof.

In the three toilet rooms in the basement, automatic vent dampers of thin oiled silk louvres are placed behind the vent register faces at the floor to prevent any movement of air down the vent flues through the rooms to the rest of the building.

The exhaust fan for the main ventilating ducts is 48 inches in diameter, of the propeller type, with vertical

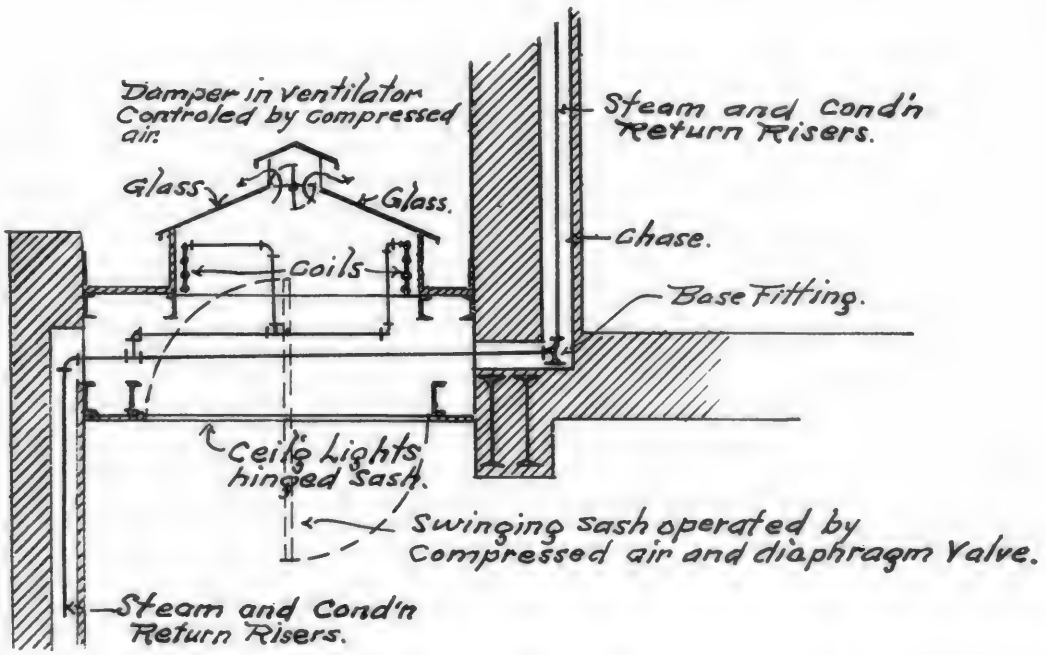


PLAN OF FIRST FLOOR OF REDMOND BANK BUILDING, SHOWING LOCATION OF VENTILATING REGISTERS AND RADIATORS

shaft, and direct connected to a motor. The fan will deliver 10,000 cubic feet of air per minute at 400 R. P. M. The motor is similar to the blower motor and is capable of delivering 5 H. P. at 400 R. P. M.

A 24-inch disk toilet vent fan, direct connected with a ½ H. P. 230 volt motor is located in the basement and forms a part of the toilet vent duct, only the motor being left accessible. This fan will deliver 400 cubic feet of air per minute at a speed of 250 R. P. M.

To secure an effect of neatness and uniformity, where a heat and vent flue are carried close together, the heat flue is offset above the vent flue, so as to bring the two registers in a vertical line. Many of the radiators, also, on the first floor, which are located beneath windows, are enclosed in galvanized iron boxes with ornamental iron grilles.



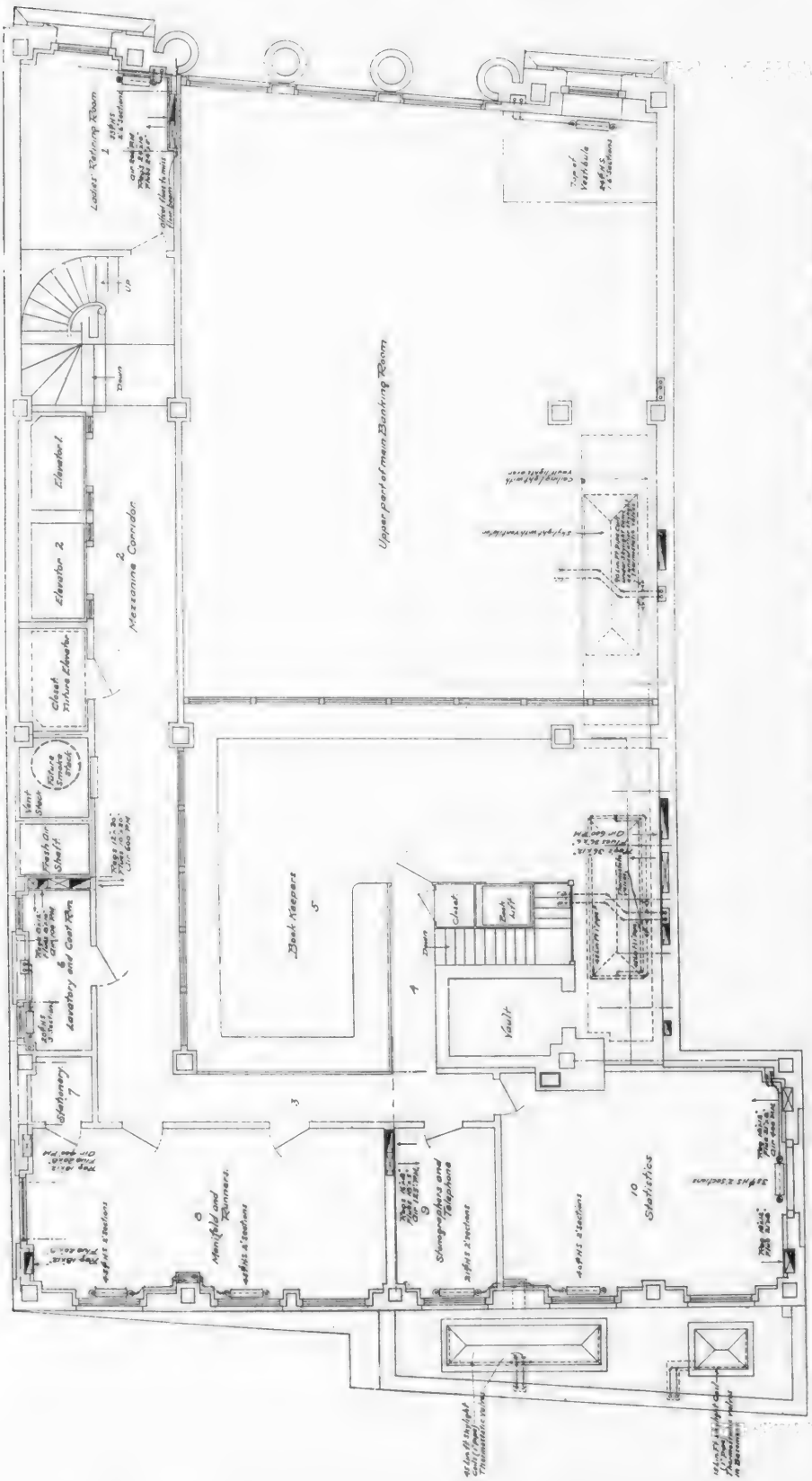
TRANSVERSE SECTION THROUGH SKYLIGHTS OVER BANKING ROOM

AUTOMATIC REGULATION

The automatic control of the system regulates the admission of steam to the radiators on the first and mezzanine floors and to the blast coils, and controls, also, as has been noted, the air mixing dampers of all supply ducts at the plenum chambers.

In a room having both direct radiation and controlled air supply, the thermostat is of the compound type, controlling both the radiators and the air mixing dampers, although, in some cases, two thermostats are used.

A separate set of thermostats is placed in the fresh air inlet shaft and in the tempered air chamber, controlling the admission of steam to the indirect reheater and tempering coils and controlling the flow of condensation water through the four-row tempering coil. Two thermostatic valves, designed to operate in unison, are placed on the 3-inch condensation supply and the 3-inch by-pass to the four-row tempering coil, the by-pass to open as the supply closes. A third valve is attached to the discharge from the four-row tempering coil to operate in unison with the supply valve to the coil. All direct radiators having thermostatic control have valves on the supply and return connections working in unison. The return connection from the reheater coils have check valves instead of



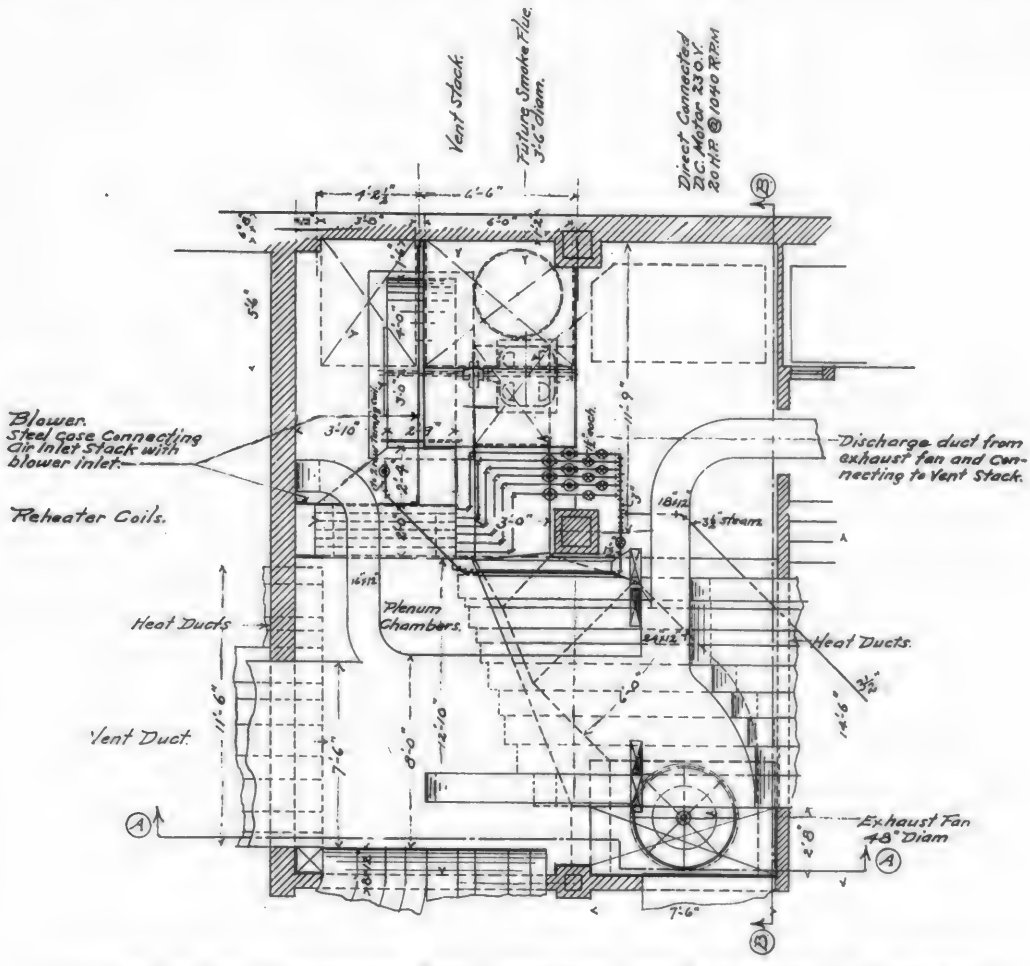
PLAN OF MEZZANINE FLOOR OF THE REDMOND BANK BUILDING, SHOWING ARRANGEMENT OF COILS IN SKYLIGHTS

thermostatic valves. One thermostat placed in the tempered air chamber is connected to control the by-pass damper around the tempering coils.

The control of the tempering coils, by-pass damper and reheater coils is accomplished in the following manner: Cold air thermostats are placed in the cold air intakes to control the admission of steam to the reheater coils in inverse proportion to the temperature of the incoming air; a cold air thermostat controls the admission of steam to the two-row tempering coils, so that when the temperature in the intake is below 40° F., steam will be admitted to the coil to protect the four-row hot water coil.

A thermostat in the tempered air chamber opens the by-pass damper when the temperature in the chamber rises above 60° F. A second thermostat in the tempered air chamber bypasses the supply to the four-row hot water tempering coils when the temperature in the tempered air chamber rises above 65° F.

Two additional diaphragms are located in the two skylights over the main banking room to control the skylight ventilator dampers and the horizontal ceiling sash beneath the skylights. These diaphragms are controlled in the basement.


Vent Stack.
Fitting Smoke Flue 3'-6" Diam.
Direct Connected D.C. Motor 230 V. 20 H.P. @ 1040 R.P.M.
Blower. Steel case Connecting Air Inlet Stack with blower inlet.
Reheater Coils.
Discharge duct from exhaust fan and Connecting to Vent Stack.
Heat Ducts
Plenum Chambers.
Heat Ducts.
Vent Duct.
Exhaust Fan 48" Diam
A
B

PLAN OF HEATING APPARATUS, WITH TEMPERING COILS REMOVED, BUT SHOWING VENT FAN AND DISCHARGE CONNECTION TO VENT STACK

STEAM CONNECTIONS

Branches from the steam supply mains in the basement, besides being carried to the various risers, are also connected to the ceiling coils in the

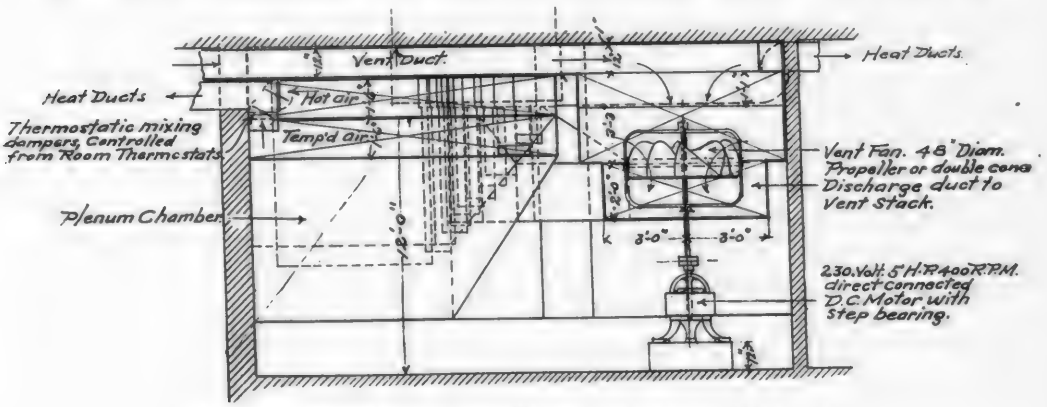
basement, to the first floor radiators, and a 3½-inch branch to the indirect coils, with an individual connection to each of the reheater coils and to the two-row tempering coils.

All branch connections to risers have bleeders at the base of the riser, as shown in the accompanying illustration, and connecting in the return with a hand-valve in each.

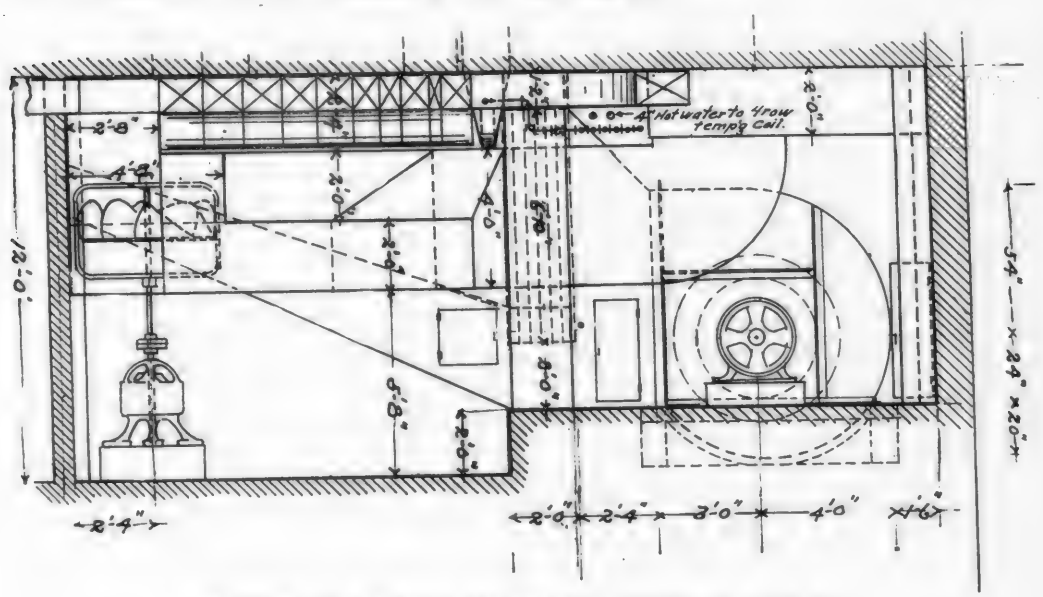
The connections of all ceiling coils in the basement are by means of the two-pipe system. Connections to radiators on the first floor are made on the basement ceiling, thence vertically through the ceiling to the radiator outlet, the thermostatic valves controlling same being placed on the basement ceiling. All connections to radiators above the first floor level are exposed in the rooms which the radiators supply.

The return mains of the front and rear portions of the building are united at the fan room and connected to three discharge traps. Thence a 3-inch discharge line connects to the inlet opening of the four-row tempering coil.

From the condensation base of each reheater coil a 1¼-inch pipe is connected with a 1¼-inch horizontal swing check valve at a point near the coils, and the discharge united into a



SECTION OF HEATING APPARATUS, TAKEN ON LINE A-A

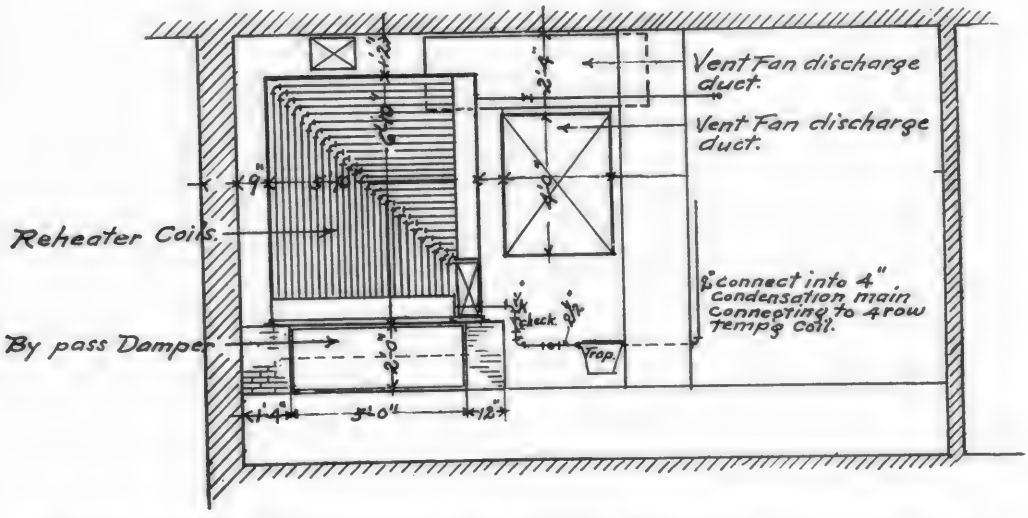


SECTION OF HEATING APPARATUS, TAKEN ON LINE B-B

2½-inch discharge main connecting to three traps similar to those already mentioned. From the discharge of these three traps is carried a 2½-inch discharge connection, which is united with the 3-inch discharge connecting to the four-row tempering coils.

cooling tank is of boiler iron, having a shell 4½ feet in diameter by 12 feet long, and containing 275 linear feet of 3-inch wrought iron pipe.

At a point near the junction of the two discharge lines from each set of condensation traps is a 3-inch by-pass



SECTION AT FRONT OF REHEATER CASE, SHOWING REHEATER COILS, FOUNDATIONS AND BY-PASS DAMPER

From the return header of the four-row tempering coil a 3-inch discharge connection is carried to a cooling tank with a horizontal swing check valve at the tempering coil and a 3-inch gate valve at a point near the wall of the apparatus room. The connecting into the 3-inch main to the cooling tank.

Bruce Price & De Sibour and John Russell Pope are the architects of the building, Mr. Burt S. Harrison the consulting engineer, and Walker & Chambers the contracting engineers.

Apartment House Heating

By J. Byers Holbrook

The remark has frequently been made during the past few years that New York city is fast becoming a community of cliff dwellers—that many families are giving up the housekeeping of private residences and are turning to flats, apartments or apartment hotels for their living abodes.

This is in a great way true, as a cursory perusal of the real estate news will convince the reader.

These apartments, whether housekeeping or what is generally known as the hotel apartments, are in the majority of cases speculative jobs, which are cheaply put up by investors or building companies and for which the architects receive far from a remunerative compensation.

It naturally follows that the latter hardly feels called upon to go down into his pocket to any great extent, with the result that all details as to the design of the engineering features, such as steelwork, steam power, heat (ventilation, if used), and electrical work, are invariably turned

over into the hands of a contractor whose services cost neither the architect nor the owner a cent.

Assuming that the architect receives this small fee, he hardly can be censured for handling the work in the above manner, and looking at it from the side of the owner, the latter, as a rule, figures the job as a speculative one and is not inclined to pay out any more money than he absolutely has to. For the above reasons this class of building is apt to be cheaply put up and the incident mechanical features are installed on the cheapest possible basis.

The steam plant of both the housekeeping apartment and the apartment hotel almost invariably consists of return tubular boilers, which is the case of the former usually feeds a gravity return, one-pipe heating system, although there are some buildings of this nature where a small plant will be added consisting of an ice making or refrigerating plant (usually of the absorption type), engines and generators, the exhaust steam being used in the heating system. The hotel apartment plant almost invariably consists of all of the above.

While the majority of the apartment house steam plants usually employ the return tubular boilers, there are many of these buildings of the smaller sizes which use for their gravity return heating systems the standard form of sectional cast-iron low pressure heating boilers. The writer sees no objection to this kind of an installation, for this type of heating boiler is well adapted to a not too large heating system; they are less expensive as to initial cost and, with a fair amount of careful management, they are not expensive in operation. These boilers, even in the largest sizes, are simple in construction, there is less to take care of, and they can be built up in sections and installed to carry up to 9,000 to 10,000 square feet of radiation.

As regards the return tubular type of boilers for steam heating they should not, in the opinion of the writer, be made larger than 72 inches in diameter, neither should they contain a comparatively large number of small size tubes, for when so constructed the cramping thus resulting is apt to interfere with the proper water circulation. Every precaution should be made to secure fairly dry steam, for if much water is carried into the supply mains, extra provision will have to be made in all mains to secure the elimination of this water.

The writer prefers a generously large proportioned steam dome, well secured by proper bracing and stays, to the ordinary dry pipe in the shell. In furnishing these domes it is advisable to cut a sufficiently large number of holes in the shell under the dome, such that the total area of all holes shall be equal in area to the area of the steam nozzles taken off.

For grates it will be found best to use a shaking type for the reasons that the fire doors are not opened for cleaning, the fire box is apt to last longer, not being exposed to shrinkage and deterioration caused by cold air coming in contact with the heated surfaces, the firing is apt to be more regular and the duty is less arduous and exhausting on the attendant.

In regard to blow-off valves, the writer is of the opinion that a good "Y" valve is to be preferred to a heavy packed blow-off cock, as the former imposes less work on the fireman. This, however, is a matter of opinion. The heating system of a typical New York apartment house is installed on the one-pipe up-feed layout, provision being made to drip the heels of all rising lines into the return mains. In some few cases drip lines and mains are connected to the radiator air valves, but where such lines are provided they are usually installed in sizes too small. It would be far better to use ¼-inch air lines from air valves and generously proportion the air risers and mains, and to have all of this piping valved so that the individual risers and sections could be tested when required. In the majority of plants, however, not even drip lines are provided, a cheap form of so-called air valve being attached to the radiating surfaces only and such valves, either from improp-

er attachment or inefficiency of the valves themselves, work so poorly as to create air binding and prevent the proper circulation of steam.

Many of these apartment houses use heating risers in toilet rooms, servants' quarters and kitchens. While this makes an inexpensive way of heating, the practice, in the opinion of the writer, is much to be condemned, for the reason that there is naturally no control over the heat of these rooms.

The best place to locate radiators, especially as regards heating efficiency, is undoubtedly under the windows, for there cold drafts are overcome and if the radiators are to be recessed or set in panelbacks (though same is hardly likely in a cheap building) they are out of the way.

Some owners, however, take the ground that where radiators are set exposed under windows they are apt to soil and interfere with lace curtains. The contractor, however, prefers invariably to use the standard 38-inch high radiator and set the same in corners. This is a much cheaper installation on account of the increased height of the radiator and the shorter connection which is required to radiator.

In closing the writer desires to say that while he favors the two-pipe system of heating for office, general mercantile buildings, etc., there is some ground, he will admit, for using the one-pipe system in apartment houses, for one valve on a radiator makes the operation of the same much simpler to the average apartment house dweller.

Piping Problems in Public Buildings

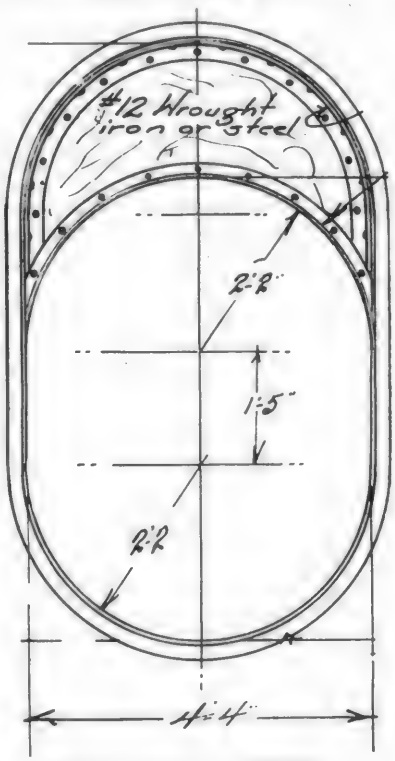
The New Commercial High School, Brooklyn, N. Y.

As an example of complicated piping problems met and solved in the heating of public buildings or other structures containing large auditoriums, the plant in the new Commercial High School building in Brooklyn, N. Y., offers an interesting study. The difficulty here arose through the fact that the building in question contains a large auditorium and a gymnasium, one situated in the rear and the other in the front of the building.

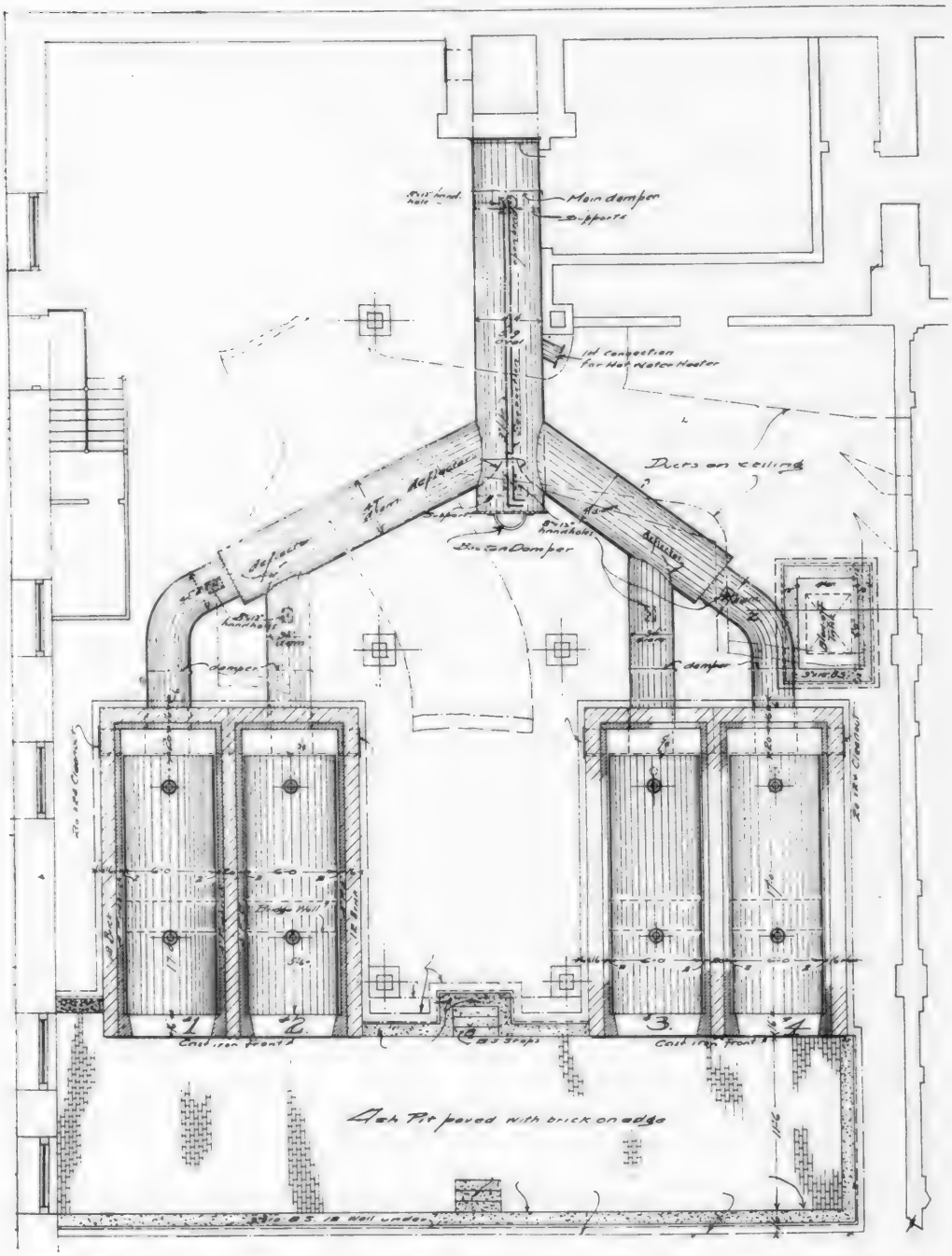
In addition to this it was necessary to provide for three levels of supply and return piping, owing to the extension of the auditorium and gymnasium under the wings of the main building.

The steam heat is furnished through reducing valves from four horizontal tubular boilers. For the indirect radiation used in the ventilating, the piping is carried to two central heating chambers, each one of which is made up of three divisions. There are nine groups in each division, six groups containing 12 sections each and three groups containing 11 sections each, thus making 5,250 square feet for each chamber.

Each division of heaters is supplied through a separate supply main, and the return pipes, also separate, ex-



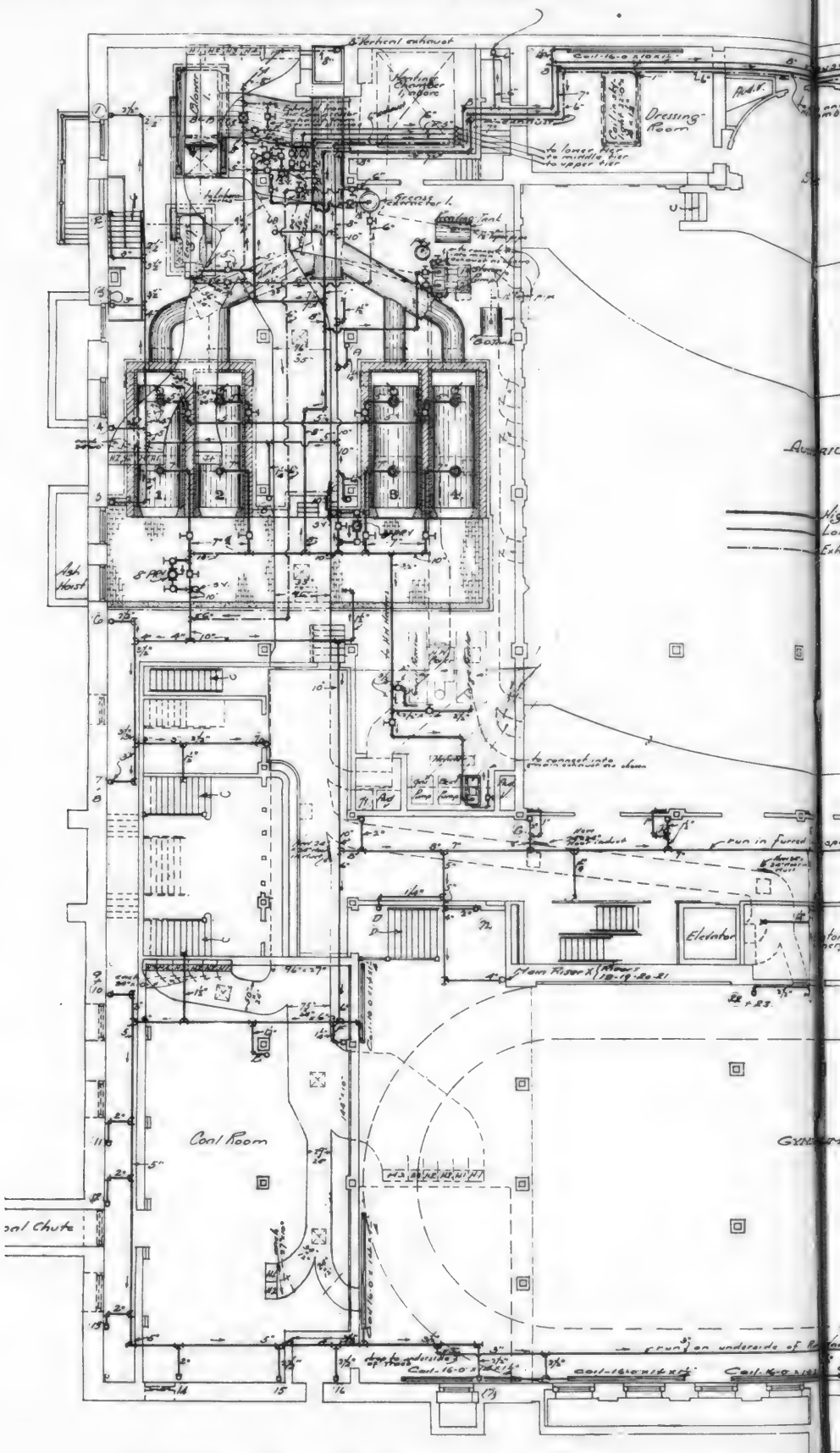
SMOKE FLUE CONNECTION



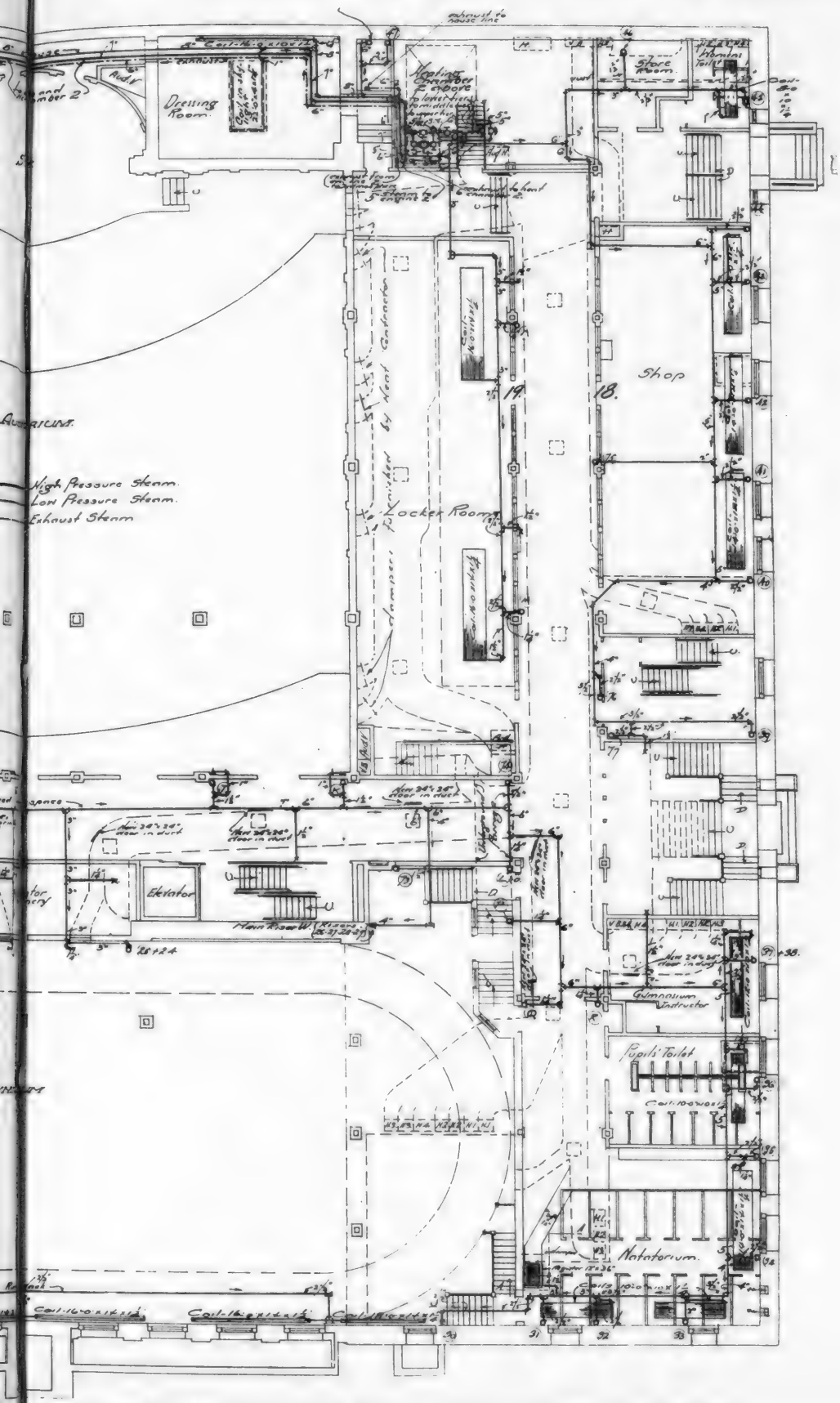
PLAN OF BOILER SETTINGS IN NEW COMMERCIAL HIGH SCHOOL, BROOKLYN, N. Y.

tend from each group of sections to points near the floor where they are connected into separate manifolds for each division. The arrangement of one of the heating chambers is shown in detail in the accompanying illustrations.

The high pressure piping, besides furnishing steam to the engines, etc., runs to the demonstration tables and to the vapor baths in various parts of the building. It connects, also, with two Physical Laboratories, a Preparation Room and a Physical Lecture Room on the third floor and with similar rooms used as Chemical



BASEMENT PLAN OF THE NEW COMMERCIAL HIGH SCHOOL, BROOKLYN, N. Y.



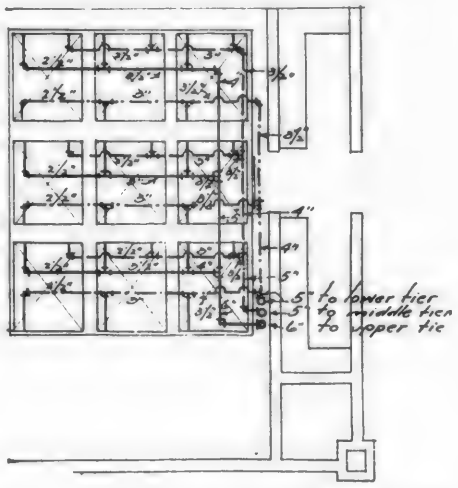
SHOWING GENERAL ARRANGEMENT OF STEAM PIPING AND VENTILATING DUCTS

Laboratories, etc., on the fourth floor. The connections to the eight Demonstration Tables are run through closets of the tables with the valves inside to prevent tampering. An additional precaution is the use of special brass plates marked "Danger, Live Steam" on top of the tables. There are no return connections from these tables. The coils of each of the two vapor baths are provided with return connections.

In the Chemical Lecture rooms each fume hood is connected to a positive pressure blower, with direct connected, 220 volt, direct current motor. The outlet of each blower is connected to the pipe leading through the fume hoods by a one-inch pipe.

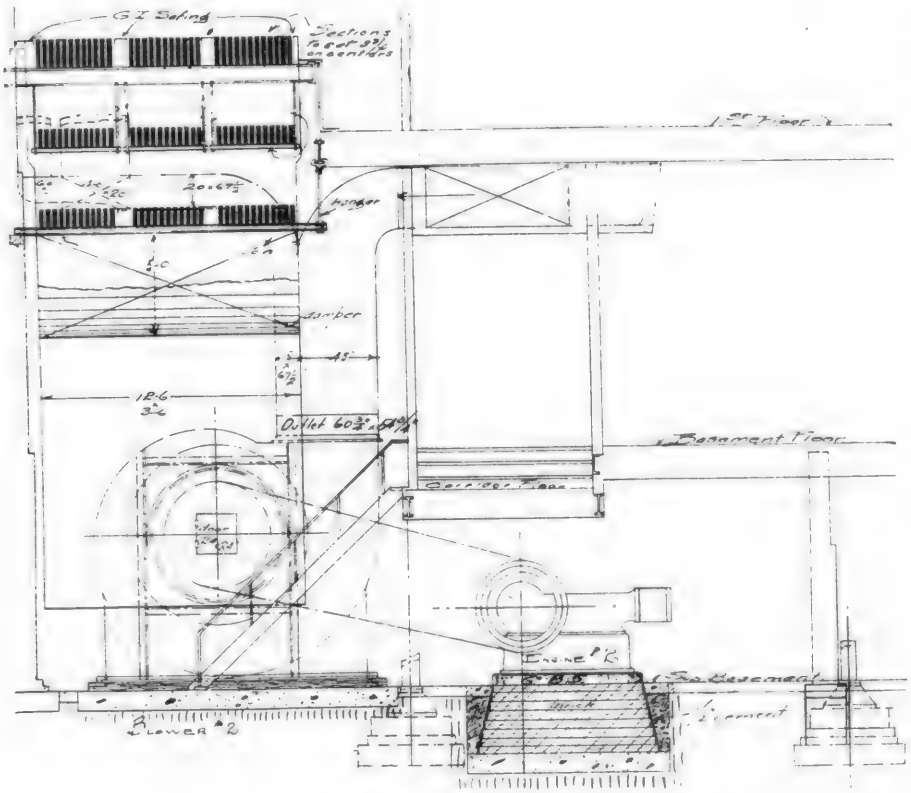
There is also a snow melting apparatus, consisting of steam and water pipes connected with a Y fitting and located in the boiler room. Thence delivering pipes extend to the roof over the auditorium and to the roof over the gymnasium. Steam connection is taken from the pump steam line, and the water pipe from the main.

In the direct radiation separate re-

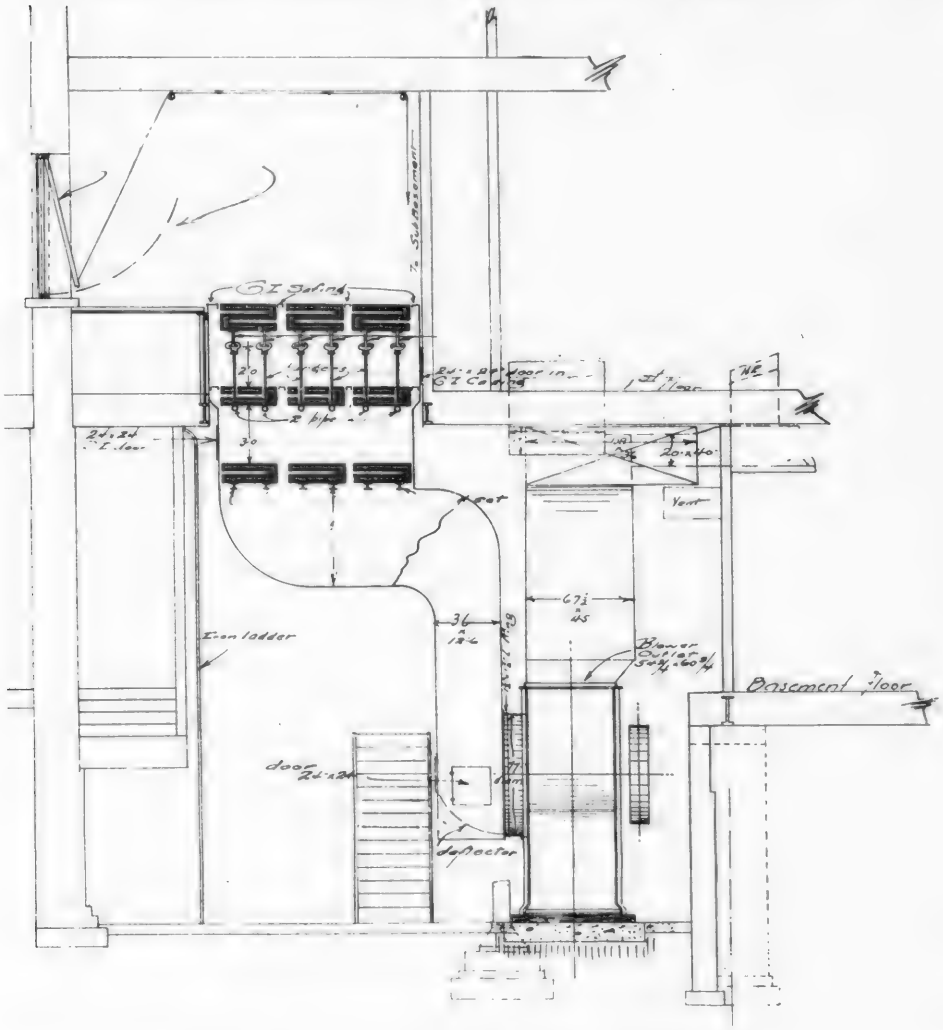


PLAN OF HEATING CHAMBER No. 2, SHOWING STEAM CONNECTIONS

turn pipes extend from all radiators and coils and connect near the basement, first or second floors, as the



DETAIL OF HEATING CHAMBER AND BLOWER No. 2



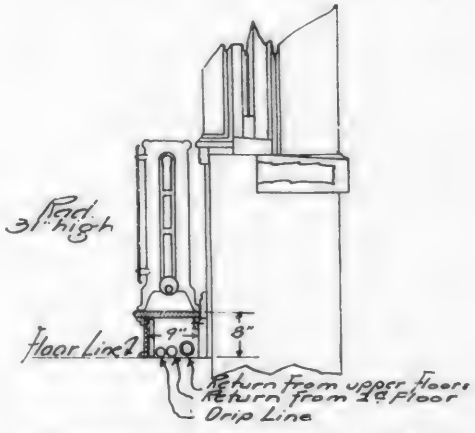
DETAIL OF HEATING CHAMBER AND BLOWER No. 2

situation requires, into branch tee headers and thence to the main return.

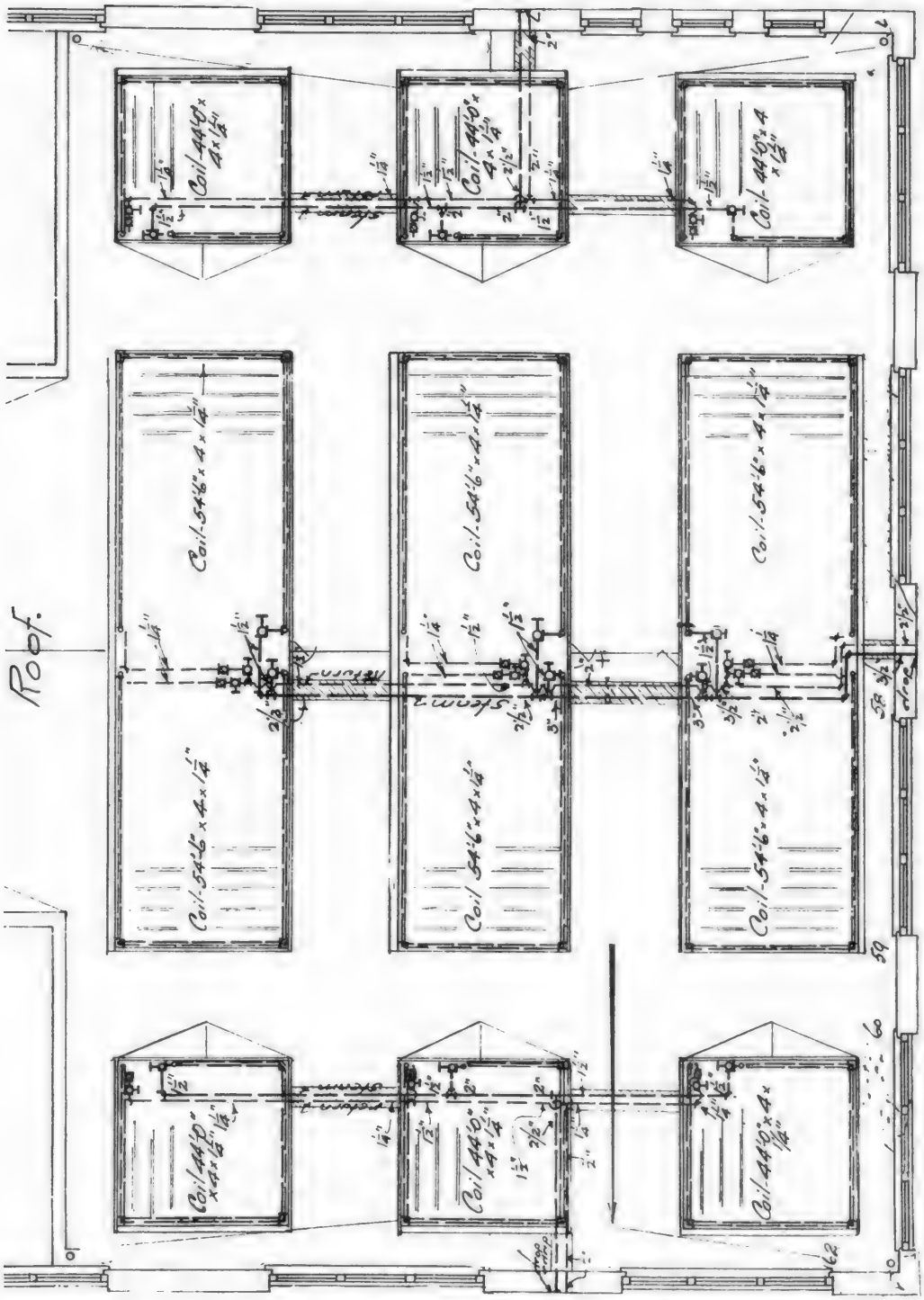
The ventilation is accomplished by means of two blowers, each nine feet in diameter, one full housed and the other three-quarter housed, each blower is to be run at 185 revolutions per minute, and will be operated by steam engines, belt connected.

The air, after pasing through the two heating chambers, is carried in galvanized sheet iron ducts to the vertical flues leading to the various rooms. Where steam and other pipes pass through the ducts they are increased in size proportionately at such points.

In addition to the other fresh air flues, a fresh air supply pipe is run from the main supply duct to an indirect heating chamber in the Natatorium, this chamber consisting of eight



SECTION SHOWING RADIATORS SET ON CASING



ARRANGEMENT OF SKYLIGHT COILS OVER AUDITORIUM IN NEW COMMERCIAL HIGH SCHOOL BUILDING, BROOKLYN, N. Y.

sections of indirect radiators hung from the ceiling. All of the vent flues are carried to vent chambers at the roof, where each is provided with adjustable dampers and vent hoods or caps.

The auditorium, being surrounded on nearly all sides except the roof by the other parts of the building, has little exposed wall and window surface and is heated almost entirely by the plenum system. The roof glass exposure is heated by coils in the skylights, as shown.

The temperature throughout the building is automatically controlled. Each classroom has one thermostat to control the direct heating surface and the larger rooms have thermostats in number to amply control the temperature in all parts. In addition, the temperature of the inflowing air is controlled by thermostats placed in the blower discharges and connected to the heating chambers. Two thermostats are attached to each of the two lower divisons, one arranged for 70° F. and placed in the main duct supplying the main building, and the others arranged for about 90° to 100° F. and placed in ducts leading to the auditorium. Mr. C. B. J. Snyder, chief architect of the Department of Education in New York City, is the architect of this school building, and Mr. Frank G. McCann, the designing engineer. The constructing engineers are Blake & Williams, of New York.

Leakage of Steam Engine Valves.

In order to establish the laws of leakage through a sliding joint, flat slides are, no doubt, the simplest, and, therefore, the best forms to experiment with; but with drop valves one has to do with a fixed and not a sliding joint. If one wants to investigate leakage through a sliding joint, surely the scientific method is to use a slide covering only one port, namely, the exhaust port; to arrange means whereby the mean lap may be varied without altering the fit between the sliding faces; to arrange means of varying the mechanical pressure between the faces independently of the pressure which produces leakage; to adopt means of varying the fit between faces independent of all other change, and of varying the temperatures as well as the pressures effective in producing warpage of either face.

Workshop experience with manifold forms of valve has long since demonstrated that the true secret of steam tightness lies in the design of valve and seat together in regard to mass, shape and surface exposures to live and exhaust steam respectively such as, while it leaves both valve and seat the greatest practicable freedom to change in size under variations of temperature and pressure, will also keep both of unchanged shape.

As regards leakage, a distinction should be sharply drawn between leakage between a pair of very narrow bearing surfaces, such as those of drop valves, and that between wide lap surfaces, such as those in flat, piston, and Corliss slides. In the former case the leakage approximates to the flow through a pin-prick in a thin plate, and there is no reason to suppose that the passage between the metal surfaces compels condensation of steam in any degree greater than in the small orifice in the thin plate. If the bearing edge has more than a certain width, there may be a simmering leak, which means that the leaking material issues as liquid, and boils immediately it escapes into atmospheric pressure. But if it were a sharp knife-edge there would be a blow through of steam alone if only steam arrived at the high-pressure side of the joint.

It would be interesting to discover the limit of breadth that separates this kind of leak from that through wide lapping surfaces. Here the high conductivity of the metal promotes a more or less rapid flow of heat towards its cooler parts; this flow keeps the metal surface which is in contact with the steam at a lower temperature than the layer of steam within its radius of direct thermal influence; and consequently heat flows from the steam to the metal, or rather, to both the opposite metal faces.—Prof. R. H. Smith, in *The Engineer*.

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AS announced last month, we commence in this issue the publication of a series of articles by Prof. J. H. Kinealy on designing and proportioning piping for conveying air. This, we should say, is a matter that, just now, is occupying the center of the stage, so to speak, among heating and ventilating engineers. Certainly every new authoritative statement upon the subject is eagerly absorbed by the heating profession, as well as by many architects who for some time now have found it expedient and even necessary to continually "read up" upon the rapid developments in the heating art. This was shown, in a marked degree, by the wide circulation that was given Professor Kinealy's recent paper on "Flow of Air in Metal Pipes," read at the Chicago meeting of the heating engineers, the paper being reprinted in many papers only indirectly connected with the heating trade.

Numerous requests for a further elucidation of this important subject resulted in the preparation of the present series of articles now being published in this magazine and which will doubtless attract the same wide range of interest accorded Professor Kinealy's original paper.

SPEAKING of the developments in heating and ventilating practice in the last decade or two it was interesting to hear read at the Chicago meeting of the heating engineers Professor Baldwin's statement, taken from his book, "Steam Heating for Buildings," that "it is not profitable to dry by forcing air, as with a fan or blower, in connection with steam coils." "This," said the speaker, "was said a little over twenty years ago. Since then, drying by fan blowers has practically superseded all other methods." All of which only emphasizes the growth of the art and the value of up-to-date information that comes from reliable sources.

Yet men like Professor Baldwin are the first to admit that "the world do move," and as a proof of their own progressiveness they are frank to say that it is impossible in these days to authorize a work of reference regarding heating, barring, of course, the essentials, that will remain as a standard for an indefinite period.

PLANS of heating systems in modern mercantile buildings, such as banks, and in more costly residences, are sure to delight the eyes of the designing engineer, as well as all right-minded contractors. In these classes of buildings are to be found, perhaps, the most perfect installations and the most strictly up-to-date practice, with those little touches of luxu-

ry that cause the systems to do many works of supererogation which, while not absolutely needful, are, nevertheless, appreciated and have their effect in establishing ideals for the profession to live up to. It is our purpose, from time to time, to present in our columns plans of this description, and while those of one of New York's newest bank buildings, to be found in this issue, are designed to serve strictly utilitarian purposes, yet they show, in many of their features, the extensive demands that are made nowadays of heating and ventilating plants.

QUITE another class of installations is to be found in those buildings that come under the head of "Public." Here, where the demand is always for the maximum degree of efficiency with the minimum degree of expense, are to be found very often those curious incongruities that bring a smile to the face of the discerning observer. For example, not long ago an admirable boiler installation in a costly public building was so complete in every other detail that the absence of an induced draft attachment led to more than one inquiry as to why this useful adjunct had been omitted. It was then explained to be due to the ever-watchful spirit of economy that breathes over public work in a way that countenances a certain amount of expenditure and then stops short in its tracks before the object is attained. In the case in question, an induced draft fan had been included in the original plans and then yanked out bodily because the total expense of the plant was some hundreds of dollars above the appropriation.

In spite of this economical tendency, however, the heating and ventilating installations to be found in many of our public buildings, especially schools, are on a scale that reveal a "powerful lot" of persuasive argument in the interests of the best heating practice on the part of the architects and engineers having charge of the work.

A plant that represents the high standard attained in the design of heating systems for schools is that provided for the new Commercial High School building, in Brooklyn, which is described in this issue.

PROBABLY the first act of the Department of Commerce and Labor to bring the heating trade into any like close relations with it is a request that has just been sent out by the Bureau of Manufactures requesting the co-operation of manufacturers generally in extending the foreign trade of the United States. The idea is to establish a comprehensive card index which will enable the Department, upon application, to furnish, to intending purchasers, for instance, whatever information regarding any manufacturer or his product that such manufacturer would desire to have imparted.

AT the mid-winter meeting of the American Society of Heating and Ventilating Engineers there was some discussion regarding the relative merits of overhead and under feed systems of hot water heating, and the desire was expressed by many that this subject might be taken up in a more comprehensive manner than had been done. It will be a matter of interest, therefore, to our readers to know that our October issue will contain an important article on this subject by a heating engineer who has given considerable time to the study of these two methods of installation.

District Steam Heating*

What to do with his exhaust steam is a question for the manager to decide. Which is best: To install condensers and thereby increase the efficiency of the engines 20 per cent. or more, and the capacity as well; or to sell this by-product as it is, in the form of heat? If the rates obtainable are fair, that is, if the heat can be sold nearly on a live steam basis, the plant should receive from the latter course at least three-quarters of the original value of the steam; while a condensing outfit would save but one-quarter to one-third of its value. If water for condensing is not available, the argument for district heating is strengthened. Very many plants have short and sharp winter peak loads; and it would seem that under such conditions their managers might be warranted in installing some inexpensive, simple, non-condensing engines, the exhaust from which would be well utilized for heating purposes; or it might even prove to be best, under proper conditions of load and fuel costs, to install condensing apparatus which would be run during the summer, but which in the heating season would be cut out, the exhaust steam being then utilized on the heating system. The use of exhaust steam for heating will necessitate the carrying of some back pressure on the engines, thereby reducing both capacity and efficiency, a point not to be lost sight of.

CALCULATING CAPABILITIES OF EXHAUST STEAM

Before making the investment, the manager desires to know what income he may expect and how many square feet of radiation his exhaust steam will care for. Knowing the pounds of water per horse power per hour consumed by his engines, and referring to his load curve of the previous winter, he can readily figure the minimum amount of exhaust steam that can be counted on for any single hour, and this should be the basis of his figures. Now come certain deductions: feed-water heaters and station leakage will probably take 15 per cent., while losses in mains and services may be as much more, though on the latter point we can cite one plant where the losses are less than 3 per cent.

The returns that the committee obtained from steam-heating plants indicate that it is safe to figure for ordinary conditions about 0.20 lb. of water per hour per square foot of radiation (varying from 0.05 to 0.50). As all the consumers are not using the steam at the same time, particularly if on a meter basis, the load factor should be no more neglected than in the lighting business. Naturally, with the heating business this is higher; and if the figure of 85 per cent. is used it will probably be on the safe side.

Together with the above must be figured the interest charges on the total underground installation and that portion of the central station plant which is used for heating purposes; and lastly—depreciation—an item that is often neglected, but which should nevertheless be estimated. From the best evidence at hand the last item seems to be about 5 per cent. per annum on the total cost of the investment.

LIVE STEAM SOMETIMES NECESSARY.

Though it is generally considered good practice to limit the heating business to that which can be taken care of by the exhaust steam, in many cases live steam has to be supplied at certain times in order to give good service. Where this condition exists and the demand on the live steam increases, it soon becomes necessary to set aside or to install a boiler solely for this purpose. Then comes the turning point of the plant. The chances are that it is selling live steam on an exhaust steam basis, and it soon becomes evident, if the question is investigated, that there is no profit in the business. This condition

*From a paper read before the convention of the National Electric Light Association, by W. H. Blood, Jr., being data prepared by Messrs. W. H. Blood, Jr., R. S. Wallace and C. R. Maunsell.

of affairs has occurred repeatedly and in many cases has both cut down the net earnings of the company and given the heating business a bad name.

If the heating business is to stand upon its own merits, it is unwise to go into it on any other basis than that of live steam. If, however, it is the intention to supply heat where so doing secures good consumers of electricity and for the express purpose of getting such consumers, it brings up entirely different considerations. In this connection it is well to note that the heat required for buildings that might be consumers of both electricity and heat, is so great that even if all the exhaust steam of the entire plant were utilized for them there still might be a deficiency; in other words, the ordinary building requires more steam to heat it than to light it. It therefore behooves the careful manager to direct the growth of business on the heating system in the direction that will bring the greatest number of good consumers of electricity, and to this end all extensions of mains should be carefully considered, remembering that the supply of heat is limited. It naturally follows that the necessity for soliciting or advertising the heating business alone seldom exists after the first or second season.

SERVICE CONNECTIONS IN STREET MAINS SHOULD BE LIMITED.

It is advisable to limit the service connections made in street mains to the fewest possible, making extensions, wherever practicable, from service pipes in adjacent buildings, with due regard, however, for the capacity of the service from which the extension is made. For this and other reasons it is essential that all service pipes, extensions of same and service valves should be laid and owned by the central station.

RELATIVE MERITS OF METER RATE AND FLAT RATE.

Theoretically, a meter rate is the only equitable method of charging, but practically it may be found that a flat rate will answer the purpose fully as well. The previous failures to produce a reliable meter had until recently prevented the general adoption of this system of charging, but from the success of the past year with new meters, and with the assurance from the manufacturers of still further improvements, it is probable that the meter basis of charging will become more popular.

When electricity is sold on a flat rate basis the consumer invariably leaves lights burning at times when they are not needed, simply because it adds somewhat to his comfort, for generally speaking too much light is impossible. On the other hand, too much heat is nearly as bad as too little, and the consumer naturally takes pains to shut off the steam when the room begins to be uncomfortable. Although there is a wide difference of opinion in regard to the amount of light required for proper illumination, it is generally conceded that the temperature of a room should not be far above or below 75° F. This would seem to form a strong argument in favor of a flat rate system.

If a flat rate is established, it is necessary to decide whether the rate shall be based on the square feet of radiation installed, or on the cubic feet of space, or on the equivalent cubic feet of space heated, which latter case takes into consideration windows, doors, masonry walls, etc.

Numerous formulas have been worked out to give approximately the number of square feet of radiation that should be installed to heat various sized rooms under different conditions of service. It stands to reason, however, that the quantity of steam used to heat given spaces under similar conditions will be approximately constant and independent of the amount of radiation installed, provided that enough or more than enough radiation is supplied to take care of the coldest days. This would appear to be an argument in favor of basing the flat rate on the number of cubic feet or equivalent cubic feet of space heated.

TESTS SHOWING STEAM CONSUMPTION UNDER VARYING CONDITIONS

The accompanying table shows that the steam consumption, as would be expected, is greatest where the average temperature is lowest and that this is an important factor to be considered in arriving at the rate to charge; that the kind of service makes very little difference in the steam consumption, although residences seem to have a greater condensation per cubic foot of contents and a less per square foot of radiation than either stores or offices; that the results, although varying widely, are near enough to justify the establishment of a flat rate, this being on the assumption that customers will use practically the same amount of steam whether on a flat or meter rate; and, finally, that if a meter rate is established a corresponding flat rate would vary according to the length of the season and average temperature, and may be easily approximateed from the figures given.

USE OF HEAT DETERMINED BY HEATERS

Class of Service.	Condensation per Sq. Ft. of Radiation per Day. Av.	Max.	Min.	Condensation per 1,000 Cu. Feet of Space Heated per Day. Av.	Max.	Min.	Ratio Cu. Ft. Space to Sq. Ft. Radiation.	Av. Temp. ° F.
Residences	3.83	5.20	1.79	51.3	75.2	27.0	76	34°
"	2.49	2.49	2.49	34.6	34.6	34.6	72	44°
"	1.69	3.22	0.54	....	....	....	....	....
Stores	4.48	10.1	1.01	29.0	50.2	11.4	115	34°
"	2.61	4.03	1.18	17.1	37.0	9.2	181	44°
"	1.94	3.77	0.64	....	....	....	....	....
"	2.32	3.4	1.8	20.0	28.5	13.6	136	40.5°
Offices	5.02	7.94	2.13	51.5	78.0	24.9	81	34°
"	2.92	3.70	1.73	25.1	32.2	19.7	120	44°
"	1.56	1.83	1.19	26.0	30.4	19.8	60	43.5°
"	2.27	3.62	0.89	....	....	....	....	....
"	2.97	3.8	1.8	29.0	49.7	14.9	111	40.5°

NOTE.—While there is a large variation between maximum and minimum, it was found when making the tabulation that most of the figures ran very close to the averages given above.

These opinions, held by Messrs. Blood and Wallace, are taken exception to by Mr. Maunsell, who is opposed to any system of flat rate charging and states that his flat rate customers in Topeka, Kan., use one-third more steam than customers similarly equipped paying by meter.

IMPORTANCE OF DRAINING CONDENSATION WITHOUT LOSS OF STEAM

The consumer should provide and maintain in good repair an approved steam trap of sufficient capacity to properly drain the condensation from the heating system of his building without any loss of steam. This steam trap must be provided with an automatic air valve and a gate valve must be placed in the inlet pipe so that the steam may be cut off for repairs and examination, as occasion arises.

There should also be a ground joint union in both inlet and outlet pipes near the trap. The trap must be so located that it will discharge by gravity into the cooling coil and with at least 6-inch head above the highest point in the coil or outlet from same.

The consumer should provide and connect to the outlet pipe of the steam trap a continuous cast-iron cooling coil, to be approved by the company, the surface of which must equal one-fifth of the radiation supplied with steam. This cooling coil must be connected as an indirect radiator, properly encased in galvanized iron and supplied with cold air in an approved manner, the heated air being carried to some part of the building where a constant supply of heat is required.

COLD AIR DUCTS

The cold air ducts must be provided with dampers and by-passes for use when steam is shut off. The cold air ducts of cooling coils should have at least one square inch area and the hot air ducts at least one and one-quarter inches area of cross-section for each square foot of cooling coil connected. Register faces must have a net area equal to that of the duct in which they are set.

The pipe supplying condensation to

the cooling coil must enter the coil at the highest point, and leave it at the bottom, and then be carried up above the cooling coil, but no higher than trap discharge, so that the cooling coil will at all times remain filled with water. The coil should be supported on a substantial iron pipe frame. The purpose of the cooling coil is to extract all the available heat from the condensation. It is an economy for the consumer, for it utilizes heat that would otherwise be wasted.

Steam must not be shut off unless proper precautions are taken to prevent freezing the cooling coils. Where a supply of heat is required in the basement, and conditions permit the installation, cast-iron hot water radiation is recommended in preference to cooling coils.

COST OF COAL.

An element of extreme importance, they point out, is the relation of the cost of steam coal to that of domestic coal. In cities where steam coal costs from $1 to $2 and domestic coal runs from $4 to $9, the company has much in its favor, and should be able to make rates that are at once attractive to the public and profitable to itself. With forty companies that report that they are doing a satisfactory business, the average price of steam coal is $2.18, while the average price of domestic coal is $5.74. Among these same companies, where the hardest conditions exist, steam coal is quoted at $1.17 and domestic coal at $1.50. On the other hand, one company reports that it pays but $4 for steam coal, whereas domestic coal costs $10 per ton.

The length of the season is a factor to be considered, especially when heat is furnished on any flat rate system, i. e., per square foot of radiating surface per season, per cubic foot contents per season, etc. When on a meter basis, however, the length of the season is of much less importance. It is well to avoid, in general, the making of contracts requiring heat during the summer months.

Do We Want the Metric System?

As matters now stand, despite the bitter opposition on the part of those opposed to it, the adoption of the metric system in the United Kingdom seems assured. For some years a strenuous warfare has been carried on between the Decimal Association, who have been making every effort to educate people as to the merits of the decimal system and to make it compulsory by law, and the British Association of Weights and Measures, whose aim and object is the preservation of the present standards. Whole volumes were written by both parties with arguments for and against. The Decimal Association and its supporters, with Lord Kelvin as one of its most active workers, has got well in the lead. A bill to render the metric system compulsory in Great Britain has passed the House of Lords and is now before the Commons. A circular issued by the Decimal Association states that more than 330 members are pledged to its support and every effort will be made to carry the bill through.

While we believe that the metric system possesses advantages above the present standards sufficient to warrant its general acceptance, and that it is merely a matter of a few years before its use will become almost universal, the change will involve an enormous expenditure of time and money.

Such a change would affect the manufacturers of machinery and machine tools more than any other class, necessitating the re-designing of all tools and a large amount of the apparatus at present employed. —*Canadian Machinery.*

Valve Troubles

Valve troubles may be due either to defective design, material and workmanship, or to faulty installation, lack of care or abuse.

While a valve is by no means a piece of delicate mechanism, says *Canadian Machinery*, many users treat it much the same as an ordinary pipe fitting, when by exercising a little care considerable annoyance could be avoided.

Leaking through the seat when closed is the principal and most annoying of valve troubles, and is due to irregularity or unevenness of the seat or disk, which prevents perfect contact. Poor installation, lack of care, or abuse, are usually the cause of this trouble when good valves are used, and as other troubles are of minor importance in comparison, we shall treat of this one only.

To properly install valves, the following practice is recommended: Piping should be cleaned out before screwing together, and if possible the line should be blown out after valves are in place. Unless this is done, loose scale or metal chips remaining in the pipes may injure the seats or disks and cause leaks, requiring re-grinding, re-seating or renewal of disks. Red lead or pipe cement should be sparingly used and applied to the pipe only, never to the valve, because if put in the valve it is apt to be pushed inside by the pipe, stick to the seat and cause a leak.

Before screwing on a brass valve do not remove the bonnet unless absolutely necessary; close the valve tightly to make it as rigid as possible, and use the wrench only on the hexagon next to the pipe end. If used on the other end the strain is liable to spring the valve body and cause leaks, not only in the seat but at the bonnet joint.

If absolutely necessary to remove the bonnet before valve can be screwed on, extra care should be taken not to spring the body or dent the joint. A pipe wrench should never be used for this work, as it not only cuts and disfigures the work, but is apt to crush it.

The best way to loosen a valve bonnet is to hold it firmly by the squares in a good vise, screw a piece of pipe well into the valve end, then give a quick, strong pull on the pipe.

A valve should not be allowed to carry the weight of a line of piping, as this may spring the seat. A hanger properly placed has sometimes remedied the trouble with a leaky valve, which could not be kept tight before its use.

For flanged valves the pipe flanges should be made up true and close, as strains that would not affect an ordinary pipe fitting may spring a seat and cause the valve to leak. Unless fitted with a by-pass, it is best to place globe and angle valves so that the pressure will be underneath the disk when closed.

It is bad practice to use a wrench or bar inserted between the spokes of handwheel in closing down a valve. When such means are employed by one not thoroughly familiar with their construction, the seat or disk is liable to be crushed and bonnet or yoke overstrained, and the practice is really dangerous. It is better to remove the bonnet and examine the valve to ascertain the cause of leak.

Valves must be designed and constructed to stand considerable abuse, and although it is commercially important to have them as light as possible, strength should never be sacrificed to lightness. Light-weight valves are more easily injured than heavy ones, and are more liable to give trouble.

To Extend Foreign Trade

In an effort to extend the foreign trade of the United States the Department of Commerce and Labor proposes to establish a card index which will enable the Department, upon application, to furnish information desired by manufacturers, or by intending purchasers, and it is contemplated to extend the system to our principal consulates.

To this end the Bureau of Manufacturers is sending out a blank containing these inquiries, which the recipient is requested to answer and supplement them with any additional information he may have: Name and address (main office); location of branch establishments; description of product; capital; capacity per day, month, or year; where product is sold (if abroad, names of countries and ports to which shipped).

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

FEATURES OF THE WORK AHEAD OF THE PIPE STANDARDS COMMITTEE

The committee appointed by President Gormly, and consisting of Arthur C. Walworth, Boston, chairman; Burton P. Hall, New York, and E. M. Nichols, Philadelphia, will meet shortly for its preliminary work in the undertaking set out for these gentlemen to standardize weights for wrought iron and steel pipe, and weights and tappings for valves and fittings.

The timeliness of this investigation has been emphasized by two reports issued recently by the Engineering Standards Committee of Great Britain regarding screw threads and pipe threads.

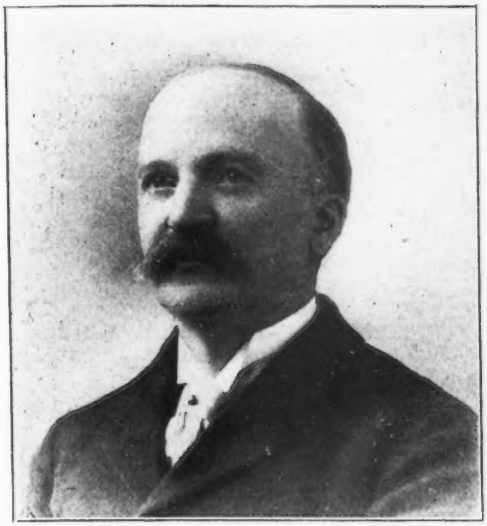
The latter report on "British Standard Pipe Threads for Iron or Steel Pipes and Tubes" contains a series of standard sizes for the dimensions of pipes and tubes and provides for uniformity in the threads for pipes of copper, brass and other materials to conform with those of iron and steel.

It is recommended that the same pitches be adopted where outside diameters agree, depending, of course, on the thickness of the pipe.

The report also recommends that the Whitworth rounded form of thread be adopted in preference to the Sellers triangular thread, in use in this country.

The Whitworth standard is named up

to 2¼-in. nominal bore, and on the larger sizes the outside diameters are made multiples of ¼ inch. The length of thread was also considered by the committee with a recommendation that it be made approximately in accordance with Whitworth's rules—0.64 times the pitch.



ARTHUR C. WALWORTH, OF BOSTON, MASS.

Chairman of the Recently-Appointed Committee to Standardize Weights for Wrought Iron and Steel Pipe and Weights and Tappings for Valves and Fittings

The report was specially designed to induce pipe makers who are using special threads of their own, to take up the question of establishing a uniform standard in these matters, and, therefore, the conclusions reached by the British committee will prove suggestive to those who are now attempting to accomplish the same thing here, if not practically furnishing a line of action for the American committee to work on.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Official announcement has been made of the dates and place for holding the approaching annual meeting. The Society will assemble at the rooms of the American Society of Mechanical Engineers, 12 West Thirty-first street, New York, January 16, 17 and 18, 1906. These dates fall on Tuesday, Wednesday and Thursday, respectively. Already papers for this meeting are in preparation, which, we understand, will include very interesting data regarding some boiler experiments that have been made by a prominent member of the Society. The report of the Committee on Furnace Data will also be made at that time.

CORRESPONDENCE

Accepted letters for this department containing practical suggestions or relating experiences that are of value to those interested in heating and ventilating will be paid for in cash. Such letters should be accompanied by illustrations when possible.

Unique System for Theater Ventilation

Editor HEATING AND VENTILATING MAGAZINE:

A rather unique ventilating system has been installed in the Lyric Theater building in this place. A 36-inch fan located on the roof, driven by a two horse power motor, supplies a strong suction which creates a perceptible draft throughout the entire building.

Numerous vents have been supplied in various sections of the theater, which give a free movement for fresh air. It was found impossible to drive the huge fan at full speed during a performance, owing to the draft and noise of the motor.

The four-foot vent through which suction is created is located directly above the center of the parquet floor. The interior of the suction pipe is painted in enamel black which removes all reflection due to the motion of the fan.

A draft of sufficient strength to lift scraps of paper from the floor of the theater to the roof is created while the fan is revolving at its utmost speed.

A switch located upon the first floor is a marvel of electric mechanism. A device is supplied giving several different speeds. A regulator which releases the current when the voltage becomes of too great a strength is a feature of the switchboard.

A. WALTERS.

St. Joseph, Mo.

Establishing a Central Heating Station

Editor HEATING AND VENTILATING MAGAZINE:

Here is the way central heating stations are being established in many parts of the Middle West and Southwest. The item is taken from the *Fort Worth* (Tex.) *Mail-Telegram*, and with the substitution of little more than the names of the parties interested, might read for any other city of the same size and description:

"Application was made to the city council Friday night, June 16, for the calling of the first election under the referendum clause placed in the city charter by the last legislature.

"The franchise sought by a company of local business men and capitalists for the establishment of a light, heat and power

plant will be the one to first go before the public.

"G. W. Armstrong, who made the application to council, states that the compay organized is composed exclusively of local capital, including Winfield Scott, W. C. Stripling and other well-known business men, who are also large users of heat and light. In this respect the company will be partly co-operative, the backers furnishing their own businesses, while offering to supply the public also.

"The council granted permission to the company to go ahead and lay the underground lines before the vote and called the election for August 29, under the referendum to grant a franchise for making light and power by electricity and gas and for furnishing steam heat, hot water and oil. Under the franchise to be sought the city will have power of rate charge regulation and will also have the power in certain events to cancel the charter.

"The plant, Mr. Armstrong says, will be begun within sixty days after the vote, and a bond of $10,000 will be made to leave all streets in good condition. Commencement of work of laying the pipes will be begun at once before the vote, the company declaring confidence that their franchise will be approved and saying that immediate work is necessary in order that the system may be ready to begin with the opening of the heating season. The plant will likely be completed by the time the vote is had.

"Under the plans of the company an electric light and power plant will be built at a cost of $75,000 a half block from Calhoun street, between Sixth and Seventh streets, on ground already purchased. The plant will have a capacity of 12,000 lights and 60,000 square feet heating capacity—sufficient, the promoters claim, to heat all buildings now using steam in the city. The gas plant, however, will not be built until the light and heat plant has been put in operation.

"It is the purpose of the company to first use live steam for making light and power and then use the exhaust steam for heating purposes, the exhaust steam having, as explained, within 5 per cent. of the value of live steam for heating purposes. A vacuum system will be installed to secure thorough circulation.

R. N. BALDWIN.

Fort Worth, Tex.

The *Cosmopolitan* and this magazine at reduced cost. See exceptional offer on page xv.

Metric Conversion Table.

Information of a general character for the use of steam fitters has become a prominent feature of boiler and similar catalogues. For instance, a recent circular sent out by the Niagara Radiator Company, describing this firm's line of fans, contains the following metric conversion table, which will be found useful in reading French and German textbooks:

Millimetres × .03937 = inches.
Millimetres ÷ 25.4 = inches.
Centimetres × .3637 = inches.
Centimetres ÷ 2.54 = inches.
Metres × 39.37 = inches. (Act Congress.)
Metres × 3.281 = feet.
Metres × 1.094 = yards.
Kilometres × .621 = miles.
Kilometres ÷ 1.6093 miles.
Kilometres × 3280.8693 = feet.
Square Millimetres × .00155 = sq. inches.
Square Millimetres ÷ 645.1 = sq. inches.
Square Centimetres × .155 = sq. inches.
Square Centimetres ÷ 6. 451 = sq. inches.
Square Metres × 10.764 = sq. feet.
Square Kilometres × 247.1 = acres.
Hectare × 2.471 = acres.
Cubic Centimetres ÷ 16.383 = cubic inches.
Cubic Centimetres ÷ 3.69 = fl. drams (U. S. P.)
Cubic Centimetres ÷ 29.57 = fluid oz. (U. S. P.)
Cubic Metres × 35.315 = cubic feet.
Cubic Metres × 1.308 = cubic yards.
Cubic Metres × 264.2 = gallons (231. cubic inches).
Litres × 61.022 = cubic inches. (Act Congress.)
Litres × 33.84 = fluid ounces. (U. S. PHAR.)
Litres × .2642 = gallons. (231. cubic inches).
Litres ÷ 3.78 = gallons. (231. cubic inches.)
Litres ÷ 28.316 = cubic feet.
Hectolitres × 3.531 = cubic feet.
Hectolitres × 2.84 = bushels (2150.42 cubic inches).
Hectolitres × .131 = cubic yards.
Hectolitres ÷ 26.42 = gallons. (231. cubic inches)
Grammes × 15.432 = grains. (Act Congress.)
Grammes ÷ 981 = dynes.
Grammes (water) ÷ 29.57 = fluid ounces.
Grammes ÷ 28.35 = ounces avoirdupois.
Grammes per cu. cent. ÷ 27.7 = lbs. per cubic inches.
Joule × .7373 = foot pounds.
Kilo-grammes × 2.2046 = pounds.
Kilo-grammes × 35.3 = ounces avoirdupois.
Kilo-grammes ÷ 907.2 = tons. (2,000 lbs.)
Kilo-gr. per sq. cent. × 14 223 = lbs. per sq. in.
Kilo-gram-metres × 7 233 = foot lbs.
Kilo-gr. per Metre × .672 = lbs. per foot.
Kilo-gr. per Cu. Metre × .062 = lbs. per cu. ft.
Kilo-gr. per Cheval × 2 235 = lbs. per H. P.
Kilo-Watts × 1.34 = Horse Power.
Watts ÷ 746. = Horse Power.
Watts × .7373 = foot pounds per second.
Calorie × 3.968 B. T. U.
Cheval vapeur × .9863 = Horse Power.
(Centigrade × 1.8) + 32 = degree Fahrenheit.
Franc × .193 = Dollars.
Gravity Paris = 980.94 centimetres per sec.